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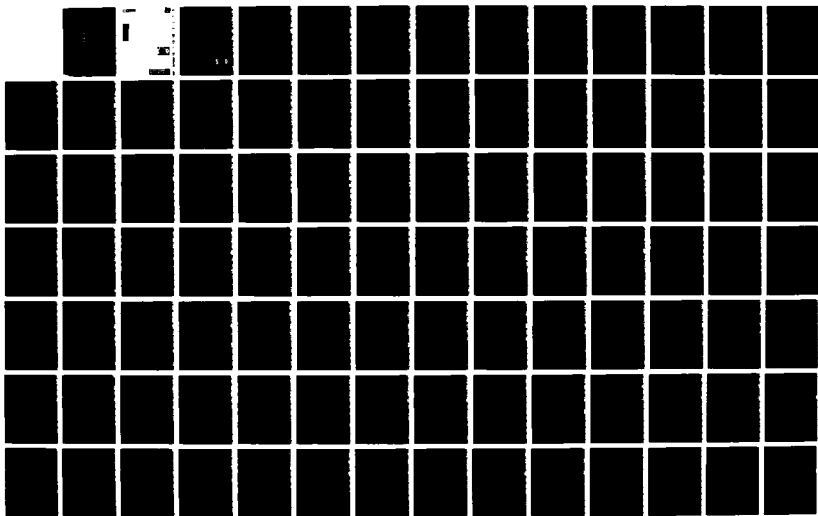
DEFENSE SMALL BUSINESS INNOVATION RESEARCH PROGRAM  
(SBIR) VOLUME 4 DEFENS. (U) DEPARTMENT OF DEFENSE  
WASHINGTON DC APR 88

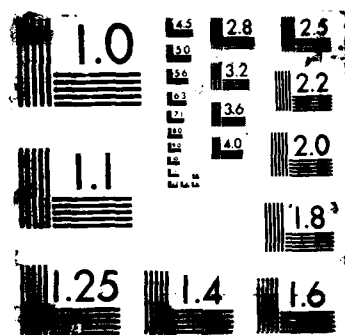
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VOLUME IV

DEFENSE AGENCY PROJECTS

ABSTRACTS OF PHASE I AWARDS

FROM

FY 1987 SBIR SOLICITATION

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April 1988

## PREFACE

On July 31, 1987 Secretary of Defense Casper W. Weinberger announced the selection of small business firms proposals under Phase I of the Fiscal Year (FY) 1987 Department of Defense (DoD) Small Business Innovation Research (SBIR) Program to be funded upon successful completion of contract negotiations.)

The selection of proposals for funding was made from proposals received by the Military Departments, the Defense Advanced Research Projects Agency (DARPA), the Defense Nuclear Agency (DNA), and the Strategic Defense Initiative Organization (SDIO) in response to the FY 1987 solicitation distributed on October 1, 1986 with a closing date of January 9, 1987.

### FY 1987 Program

	<u>Number of Topics</u>	<u>Proposals Received</u>	<u>Phase I Awards</u>
Army	330	2402	331
Navy	263	2004	286
Air Force	241	1863	350
DARPA	33	395	59
DNA	8	200	25
SDIO	<u>14</u>	<u>672</u>	<u>212</u>
	889	7536	1263

In order to make information available on the technical content of the Phase I projects supported by the Department of Defense SBIR Program, this report presents, in four volumes, the abstracts of those proposals which have resulted in contract awards.

This is Volume IV which contains abstracts and contacts for the 296 Phase I projects funded by the three participating Defense Agencies (59 DARPA projects, 25 DNA projects and 212 SDIO projects). Projects funded by the Military Services are published in separate volumes, as follows:

- Volume I - Army Projects (Pages 1 - 201)
- Volume II - Navy Projects (Pages 202 - 375)
- Volume III - Air Force Projects (Pages 376 - 587)

Venture capital and large industrial firms that may have an interest in the research described in the abstracts in this publication are encouraged to contact the SBIR firm whose name and address is shown.



## INTRODUCTION

On July 22, 1982 the President signed the "Small Business Innovation Development Act of 1982" (Public Law 97-219). This law became effective October 1, 1982 and was designed to give small high technology firms a greater share of Federal R&D contract awards.

The SBIR Program consists of three distinct phases. Under Phase I, DoD Components make awards to small businesses, typically of one-half to one man-year effort over a period generally not to exceed six months, subject to negotiation. Phase I is to determine, insofar as possible, the scientific or technical merit and feasibility of ideas or concepts submitted in response to SBIR topics. All DoD topics address specific R&D needs to improve our defense posture. Proposals selected for contract award are those which contain an approach or idea that holds promise to provide an answer to the specific problem addressed in the topic. The successful completion of Phase I is a pre-requisite for further DoD support in Phase II.

Phase II awards will be made only to firms on the basis of results from the Phase I effort, and the scientific and technical merit of the Phase II proposal. In addition, proposals which identify a follow-on Phase III funding commitment from non-Federal sources will be given special consideration. Phase II awards will typically cover two to five man-years of effort over a period generally not to exceed 24 months, also subject to negotiation. The number of Phase II awards will depend upon the success rate of the Phase I effort and availability of funds. Phase II is the principal research or research and development effort, and will require a more comprehensive proposal which outlines the intended effort in detail.

Phase III is expected to involve private-sector investment and support for any necessary development that will bring an innovation to the marketplace. Also, under Phase III, DoD may award follow-on contracts not funded by the SBIR Program for products or processes meeting DoD mission needs.

### Selection Criteria

Phase I proposals received in each topic area in the DoD solicitation brochure are evaluated on a competitive basis in the organization which generated the topic, by scientists and engineers knowledgeable in that area and in accordance with the following criteria:

1. The scientific/technical quality of the research proposal and its relevance to the topic description, with special emphasis on its innovation and originality.

2. Qualifications of the principal investigator, other key staff, and consultants, if any, and the adequacy of available or obtainable instrumentation and facilities.

3. Anticipated benefits of the research to the total DoD research and development effort.

4. Adequacy of the Phase I proposed effort to show progress toward demonstrating the feasibility of the concept.

The Act mandates that all Federal Agencies establish an SBIR program if their FY 1982 extramural budgets for R&D exceeded a threshold figure of \$100 million. Beginning in FY 1983, DoD must make available the following percentages of its extramural R&D budget for this program:

	<u>FY 1983</u>	<u>FY 1984</u>	<u>FY 1985</u>	<u>FY 1986</u>	<u>FY 1987</u>	<u>FY 1988</u>
Percentage	0.1	0.3	0.5	1.0	1.25	1.25
Estimated Dollars	16.7M	43M	79M	150M	202M	221M
Actual Awarded Dollars	20.6M	44.6M	78.2M	150.7M	202M	

FY 1983 Program

	<u>Number of Topics</u>	<u>Proposals Received</u>	<u>Phase I Awards</u>	<u>Phase II Awards</u>
Army	182	1121	98	45
Navy	131	944	66	45
Air Force	75	496	99	49
DARPA	8	128	12	8
DNA	<u>10</u>	<u>88</u>	<u>8</u>	<u>2</u>
	406	2777	283	149

1984 Program

	<u>Number of Topics</u>	<u>Proposals Received</u>	<u>Phase I Awards</u>	<u>Phase II Awards</u>
Army	111	758	81	35
Navy	146	859	99	52
Air Force	283	1208	162	73
DARPA	17	107	15	7
DNA	<u>8</u>	<u>80</u>	<u>12</u>	<u>1</u>
	565	3012	369	168

FY 1985 Program

	<u>Number of Topics</u>	<u>Proposals Received</u>	<u>Phase I Awards</u>	<u>Phase II Awards</u>
Army	111	808	124	69
Navy	138	851	110	58
Air Force	218	1306	249	119
DARPA	17	130	14	6
DNA	7	95	18	6
SDIO	<u>18</u>	<u>415</u>	<u>36</u>	<u>16</u>
	509	3605	551	274

FY 1986 Program

	<u>Number of Topics</u>	<u>Proposals Received</u>	<u>Phase I Awards</u>	<u>Phase II Awards</u>
Army	225	1643	245	77
Navy	190	1222	225	81
Air Force	304	1795	306	132
DARPA	22	177	44	11
DNA	7	171	46	8
SDIO	<u>12</u>	<u>552</u>	<u>154</u>	<u>38</u>
	760	5560	1020	347

Public Law 99-443, the "Small Business Innovation Act of 1986" was signed by the President on October 6, 1986. This law re-authorized P.L. 97-219 to extend the "Sunset Clause" to 1993; to continue 1.25 percent taxation of the extramural research and development budget; and excludes from taxation those amounts of the DoD research and development budget obligated solely for operational systems development.

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ADVANCED COMPOSITE ENGINEERING

350 SAGAMORE PKWY - STE #6  
WEST LAFAYETTE, IN 47906

CONTRACT NUMBER:

DR C T SUN

TITLE:

THE DYNAMIC RESPONSE AND ABLATION OF COMPOSITE LAMINAT  
COMBINED THERMAL/SHOCK AND MECHANICAL LOADING

TOPIC# 16a                      OFFICE: TALRPO

RAPID INTENSE HEATING OF COMPOSITE LAMINATES DUE TO DIRECT ENERGY WEAPONS WILL INDUCE STRONG THERMAL GRADIENTS THAT IN TURN PRODUCE DYNAMIC STRESSES IN THE FORM OF WAVE MOTION. THE OBJECTIVE OF THIS RESEARCH IS TO DEVELOP A MINDLIN PLATE FINITE ELEMENT PROGRAM FOR ANALYSIS OF THE DYNAMIC BEHAVIOR IN A COMPOSITE LAMINATE SUBJECTED TO COMBINED THERMAL/SHOCK AND SIMULATED IN-FLIGHT AERODYNAMIC LOADING. THIS PROGRAM WILL BE USED TO STUDY THE REDUCTION IN MECHANICAL AND THERMAL PROPERTIES DUE TO BREAK-OFF OF "CHARRED" MATERIAL THAT IS A RESULT OF THE ABLATION PROCESS. THE DEVELOPMENT OF THE PROGRAM WILL BE BASED ON AN EXTENSION OF THE PRINCIPAL INVESTIGATOR'S PREVIOUS RESEARCH IN THIS AREA. THE APPROPRIATE DYNAMIC TERMS WILL BE ADDED TO THE CURRENT FINITE ELEMENT FORMULATION AS WELL AS A GENERIC FAILURE CRITERIA WITH RESPECT TO THE BREAK-OFF OF "CHARRED" MATERIAL.

ADVANCED DECISION SYSTEMS

201 SAN ANTONIO CIR - STE 286  
MOUNTAIN VIEW, CA 94040

CONTRACT NUMBER:

JOHN LEHMAN

TITLE:

INTERCEPT/DATA KNOWLEDGE MANAGEMENT

TOPIC# 18a                      OFFICE: TALPRO

CURRENT KNOWLEDGE-BASED SYSTEMS REQUIRE SPECIALIZED KNOWLEDGE STRUCTURES TO SUPPORT THEIR PROCESSING AND ARE UNABLE TO PROPERLY UTILIZE OR INTERFACE WITH CONVENTIONAL DATA BASES. ADS HAS DEVELOPED AN INTERCEPT MANAGEMENT FUNCTION WHICH CAN INTERFACE TO A CONVENTIONAL THREAT DATABASE TO SUPPORT C3 COUNTERMEASURES OPERATIONS. THE INTERCEPT MANAGEMENT FUNCTION ESTABLISHES THE RELATIVE VALUE OF DATA

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IN THE DATA BASE TO SUPPORT INTELLIGENCE COLLECTION/JAMMING OBJECTIVES. THIS RESEARCH WILL IDENTIFY AND DESIGN INTEGRATED DATA/KNOWLEDGE MANAGEMENT STRUCTURES TO ENABLE THE INTERCEPT MANAGEMENT FUNCTION TO INTERFACE WITH EXISTING C3 ANALYSIS DATABASES. DATA AND KNOWLEDGE STRUCTURES WILL BE EVALUATED FOR COMPATIBILITY, WITH THE OBJECTIVE OF PRESERVING THE DATA BASE STRUCTURES. KNOWLEDGE ACQUISITION WITH DATA BASE DEVELOPERS AND USERS WILL RESULT IN A FUNCTIONAL DESIGN FOR THE FINAL MODULE, WHICH INCORPORATES A RELATIONAL DATA BASE AND THE RULES/FRAMES FROM THE INTERCEPT MANAGEMENT DECISION AID.

ADVANCED MATERIALS CORP  
4400 FIFTH AVE - (c/o MELLON INSTITUTE)  
PITTSBURGH, PA 15213  
CONTRACT NUMBER:  
H K SMITH/F POURARIAN  
TITLE:  
MAGNESIUM COMPOSITES FOR REUSABLE HYDROGEN STORAGE MOD  
TOPIC# 5a                      OFFICE: TALRPO

A PROPRIETARY APPROACH TO USING MAGNESIUM COMPOSITES FOR FABRICATING REUSABLE HYDROGEN STORAGE MODULES FOR THE NATIONAL AEROSPACE PLANE (NASP), THE X-30, IS PRESENTED. THESE HYDRIDE MATERIALS HAVE THE INHERENT CAPABILITY FOR STORING HYDROGEN AT ROOM TEMPERATURE TO DENSITIES NEARLY TWICE THAT OF LIQUID HYDROGEN. PRELIMINARY EXPERIMENTS INDICATE THAT THESE MAGNESIUM COMPOSITES CAN MAINTAIN THEIR STRUCTURAL INTEGRITY OVER MANY ABSORPTION/DESORPTION CYCLES WITH CONSIDERABLY ENHANCED KINETICS AS COMPARED TO BULK MAGNESIUM AND ITS ALLOYS. SUCH COMPOSITES, BECAUSE THEY DO NOT POWDER ON HYDRIDING, HAVE SIGNIFICANT ADVANTAGES OVER OTHER KNOWN HYDRIDES, NAMELY: 1) ENHANCED THERMAL CONDUCTIVITY BY ORDERS OF MAGNITUDE; 2) RAPID DESORPTION CAN BE ACHIEVED BY ELECTRICAL HEATING OF THE COMPOSITE RODS, THUS FACILITATING COMPUTER CONTROL OF THE POWER DENSITY AVAILABLE; AND 3) SINCE THE ELECTRICAL RESISTANCE OF A COMPOSITE ROD IS A FUNCTION OF ITS HYDROGEN CONCENTRATION, ONE CAN CONTINUOUSLY MONITOR THE FUEL REMAINING IN A ROD BY MEASURING ITS RESISTANCE. THIS NEW MAGNESIUM COMPOSITE TECHNOLOGY HAS THE POTENTIAL FOR MAKING AN IMPORTANT CONTRIBUTION TO THE DEVELOPMENT OF THE NASP-X-30.

AERO-VIRONMENT INC  
825 MYRTLE AVE  
MONROVIA, CA 91016  
CONTRACT NUMBER:  
DR P B S LISSAMAN  
TITLE:  
EQUIPMENT TO TEST AND DEVELOP R.P.V. AERODYNAMIC ENHANCEMENT DEVICES  
TOPIC# 3a                      OFFICE: TALRPO

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THE PERFORMANCE OF REMOTE PILOTED VEHICLES (RPV'S) CAN BE SIGNIFICANTLY IMPROVED BY PASSIVE DEVICES FOR CONTROLLING THE TURBULENT BOUNDARY LAYER. THESE DEVICES RANGE FROM SURFACE DEVICES FOR DRAG REDUCTION TO VORTEX GENERATORS FOR SEPARATION CONTROL. CURRENTLY THERE IS LITTLE APPLICATION OF THESE DEVICES DUE TO A LACK OF CONFIDENCE IN THEM, AND LIMITED PERFORMANCE DATA. VORTEX GENERATORS ARE ONLY USED TO SOLVE EXISTING SEPARATION PROBLEMS, INSTEAD OF BEING INTEGRALLY INCLUDED IN THE DESIGN. WITH THIS SIMPLE AND INEXPENSIVE DEDICATED TUNNEL, HUNDREDS OF POSSIBLE DEVICES CAN BE TESTED. THE RESULTS WILL SHOW WHICH DEVICES CAN BE USED TO REDUCE DRAG AND HOW VORTEX GENERATORS CAN BE USED AS A DESIGN TOOL TO SUPPRESS SEPARATION. THESE DEVICES WILL ALLOW RPV'S TO BE DESIGNED WITH ENHANCED RANGE, SPEED, AND MANEUVERABILITY. THE RESEARCH WILL ALSO GIVE A GREATER UNDERSTANDING OF THE TURBULENT BOUNDARY LAYER FOR ADVANCES IN PERFORMANCE. A VARIETY OF CANDIDATE DEVICES WILL BE SELECTED AND A SPECIAL PURPOSE TUNNEL WITH AUTOMATED INSTRUMENTATION WILL BE DESIGNED IN THE PRESENT PROJECT, PHASE I. PHASE II WILL COVER THE CONSTRUCTION OF THE TUNNEL AND THE DEVICE TEST PROGRAM.

AMERCOM INC  
8928 FULLBRIGHT AVE  
CHATSWORTH, CA 91311  
CONTRACT NUMBER:  
CURTIS V BURKLAND  
TITLE:  
HIGH POWER DENSITY COMPONENTS FOR ELECTROMAGNETIC LAUN  
TOPIC# 23a                      OFFICE: TALPRO

A SIX-MONTH FEASIBILITY STUDY TO INVESTIGATE THE USE OF CERAMIC AND METAL MATRIX COMPOSITE MATERIALS FOR THE CONDUCTING RAILS OF ELECTROMAGNETIC RAIL GUNS IS PROPOSED. CERTAIN ELECTRICAL, MECHANICAL AND THERMAL PROPERTIES OF THE MATERIAL WILL BE DETERMINED AND MICROSTRUCTURAL FEATURES OF THE COMPOSITE EVALUATED. SAMPLE RAIL MATERIALS WILL BE EXPOSED TO THE PLASMA ARC ENVIRONMENTS FOUND IN RAILGUNS TO EVALUATE ARC EROSION RESISTANCE.

AMPARO CORP  
PO BOX 2687  
SANTA FE, NM 87504  
CONTRACT NUMBER:  
JAMES J WALKER  
TITLE:  
STANDOFF MINE DETECTOR  
TOPIC# 25a                      OFFICE: TALRPO

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A METHOD FOR DETECTING BURIED PLASTIC MINE IN PRESENTED WHICH EMPLOYS THE ACTIVATION OF NITROGEN BY 14 Mev NEUTRONS AND THE SUBSEQUENT DETECTION OF EMITTED 7 Mev GAMMA RAYS. THE DETECTION SYSTEM IS TRANSPORTED BY A REMOTELY PILOTED VEHICLE WHICH PROVIDES THE REQUIRED STANDOFF DISTANCES.

ANALATOM INC  
1977 CONCOURSE DR  
SAN JOSE, CA 95131  
CONTRACT NUMBER:  
DR GABRIEL LAUFER  
TITLE:  
DEVELOPMENT OF AN INTEGRATED SYSTEM FOR THE WIND TUNNE  
OF AIR VELOCITY TEMPERATURE AND DENSITY  
TOPIC# 6a                      OFFICE: TALRPO

NEW VELOCITY MEASUREMENT TECHNIQUES, WHICH USE ArF LASER INDUCED FLUORESCENCE (LIF) IN CO2 AND IN CO FORMED BY THE LASER, ARE PROPOSED. THE NEW TECHNIQUES WILL COMBINE WITH OTHER LIF TECHNIQUES, UNDER DEVELOPMENT BY US, WHICH MEASURE DENSITY AND TEMPERATURE TO FORM WITH THEM AN INTEGRATED SYSTEM FOR SINGLE PULSE MEASUREMENT OF THREE INDEPENDENT FLOW PARAMETERS. ALL THREE TECHNIQUES ARE MOST SUITED FOR COLD FLOW HYPERSONIC (3-20 MACHS) WIND TUNNEL APPLICATIONS, THEY ALL RELY ON THE SCATTERING FROM NATURAL AIR CONSTITUENTS (N2, O2, CO2) WITH NO SEEDING REQUIREMENTS AND WITH THE NEED FOR ONLY ONE ACCESS WINDOW. THESE FEATURES MAKE THE INTEGRATED SYSTEM A CANDIDATE FOR BOTH WIND TUNNEL AND ON-FLIGHT MEASUREMENTS.

ANALYTICAL METHODS INC  
2133 - 152ND AVE NE  
REDMOND, WA 98052  
CONTRACT NUMBER:  
DR BRIAN MASKEW  
TITLE:  
A TIME-STEPPING METHOD FOR PREDICTING THE FLOW ABOUT P  
VEHICLES AT HIGH ANGLES OF ATTACK  
TOPIC# 1a                      OFFICE: TALPRO

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THE FLOW FIELD ABOUT POWERED LIFT VEHICLES CAN BECOME VERY COMPLEX DUE TO HIGH ANGLES OF ATTACK AND LIFTING JETS. IN ADDITION TO MODELING PROPULSION/AIRFRAME INTERACTIONS, THEREFORE, FLOW PREDICTION METHODS MUST TREAT THE PROBLEMS OF SEPARATION AND THE TRANSIENT EFFECTS OF PASSING VORTICAL STRUCTURES INTERACTING WITH THE AIRFRAME. ANALYTICAL METHODS, INC. (AMI) PROPOSES TO EXTEND ITS POWERED LIFT VERSION OF VSAERO BY INCORPORATING A TIME-STEPPING TECHNIQUE FOR TREATING SEPARATED FLOWS. THE BASIC VSAERO CODE HAS ALREADY BEEN SUCCESSFULLY APPLIED TO SEVERAL COMPLEX VSTOL CONFIGURATIONS; ROUTINES A PARABOLIZED NAVIER-STOKES (PNS) CODE IS BEING COUPLED WITH THE POWERED LIFT VERSION FOR BETTER TREATMENT OF ENTRAINMENT EFFECTS. THE PROPOSED EXTENSION WOULD INVOLVE THE INCLUSION OF ELLIPTIC TERMS IN THE PNS SEGMENT OF THE POWERED LIFT VERSION OF VSAERO NOT ONLY WIDEN THE SCOPE OF THE METHOD TO RELATED ASTOVL FLIGHT, BUT WOULD ALSO OFFER THE POTENTIAL TREATMENT OF TRANSIENT EFFECTS DURING TRANSITIONAL FLIGHT. THE PROPOSED PHASE I EFFORT WOULD EXAMINE THE FEASIBILITY AND PRACTICALITY OF COUPLING THESE METHODS. A PHASE II EFFORT WOULD EXTEND AND REFINE THE TECHNIQUE WHERE NEEDED AND WOULD CONSOLIDATE THE METHOD INTO A PRACTICAL TOOL.

APPLIED TECHNOLOGY LAB LTD  
15101 INTERLACHEN DR - STE 810  
SILVER SPRING, MD 20906  
CONTRACT NUMBER:  
DR MARC A FRIEDLANDER  
TITLE:  
PHOTON ECHO MEMORIES AND COMPUTERS  
TOPIC# 21a              OFFICE: PM

WE WILL BUILD A LABORATORY DEMONSTRATION MODEL OF A PHOTON ECHO MEMORY AND MAKE MEASUREMENTS RELATING TO THE FEASIBILITY OF PROPOSED ACCESS CONCEPTS AND REFRESH MODES WHICH ARE IMPORTANT TO THE VIABILITY OF A HIGH-DENSITY PHOTON ECHO MEMORY (PEM). INITIALLY A PEM WITH TWO BITS OF STORAGE WILL BE BREADBOARDED TO DEMONSTRATE THE BASIC PEM CONCEPT.

ARION SYSTEMS INC  
1012 SALT MEADOW LN  
MCLEAN, VA 22101  
CONTRACT NUMBER:  
MICHAEL G GIBBY  
TITLE:  
AN ASSESSMENT OF MILITARY APPLICATIONS OF THE AQUANAUT  
FOR OXYGEN EXTRACTION  
TOPIC# 29a              OFFICE: TALRPO



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THIS STUDY UNDERTAKES AN ASSESSMENT OF THE MILITARY MARKET FOR APPLICATIONS OF AN OXYGEN EXTRACTION TECHNOLOGY BEING DEVELOPED BY DARPA AT THE AQUANAUTICS CORPORATION. THE POTENTIAL APPLICATIONS IDENTIFIED THROUGH A LITERATURE SEARCH AND TECHNICAL DISCUSSIONS WITH DEVELOPING AGENCIES ARE SUBJECTED TO AN OPERATIONAL, TECHNICAL, AND ECONOMIC FEASIBILITY ANALYSIS TO DETERMINE WHICH APPLICATIONS HAVE THE MOST MILITARY POTENTIAL. EACH APPLICATION IS EXAMINED TO DETERMINE WHAT TECHNOLOGY BASE IS REQUIRED TO SUPPORT THE DEVELOPMENT OF THE APPLICATION. A DEVELOPMENT PLAN FOR THE TECHNOLOGY BASE AND SPECIFIC APPLICATIONS IS GENERATED.

CEMCOM CORP  
10123 SENATE DR  
LANHAM, MD 20706  
CONTRACT NUMBER:  
DR DAVID DOUBLE  
TITLE:  
CHEMICALLY BONDED CERAMICS BASED ON ADVANCED HIGH STRE  
MATERIALS  
TOPIC# 13a                      OFFICE: TALRPO

RESEARCH WILL BE CARRIED OUT TO INVESTIGATE THE FEASIBILITY OF CHEMICALLY BONDED CERAMICS (CBC) BASED ON HIGH STRENGTH CEMENTS AS REPLACEMENT MATERIALS IN VARIOUS HIGH TECHNOLOGY APPLICATIONS. ADVANCED CEMENTS HAVE STRENGTHS AT LEAST AN ORDER OF MAGNITUDE HIGHER THAN CONVENTIONAL CEMENT PRODUCTS. COUPLED WITH LOW MATERIAL COSTS AND EASY LOW TEMPERATURE FABRICATION METHODS, THESE MATERIALS OFFER SUBSTANTIAL COST/PERFORMANCE ADVANTAGES IN RELATION TO OTHER MATERIALS (PLASTICS, CERAMICS, METALS). THE PURPOSE OF THIS WORK IS TO DEVELOP METHODS OF FURTHER ENHANCING STRENGTH, TOUGHNESS AND ENVIRONMENTAL DURABILITY (PARTICULARLY THE WATER SENSITIVITY) BY CHEMICAL MODIFICATION AND MICROSTRUCTURAL POROSITY CONTROL. STUDIES WILL BE MADE ON PORTLAND CEMENT AND HIGH ALUMINA CEMENT BUT WILL ALSO INCLUDE OTHER INORGANIC CEMENTITIOUS SYSTEMS SUCH PHOSPHATE AND SULPHATE. THE DESIGN OF REINFORCED COMPOSITES WILL ALSO BE AN INTEGRAL PART OF THIS STUDY SINCE IT IS ANTICIPATED THAT HIGH STRENGTH CEMENT MATRICES WILL PROVIDE SYNERGISTIC ENHANCEMENT OF MECHANICAL PROPERTIES, NOT POSSIBLE IN ORDINARY CEMENT COMPOSITES.

CENTER FOR REMOTE SENSING  
8200 GREENSBORO DR - STE 503  
MCLEAN, VA 22102  
CONTRACT NUMBER:  
DR SUMAN GANGULY  
TITLE:  
MAGNETIC IMAGING SEEKER  
TOPIC# 22a                      OFFICE: TALRPO

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AN OBJECT WILL ELECTRICAL AND/OR MAGNETIC PROPERTIES IN THE PRESENCE OF A MAGNETIC FIELD WILL PRODUCE SOME SIGNATURE OF ITS PRESENCE OR ITS MOTION, WHICH COULD BE DECIPHERED FROM A PRECISE MEASUREMENT OF THE MAGNETIC FIELD. MAGNETIC SENSORS OF EXTREMELY HIGH SENSITIVITY ARE CURRENTLY AVAILABLE. SQUID DEVICES HAVE A SENSITIVITY BETTER THAN  $10^{-10}$  GAUSS Hz<sup>1/2</sup>. INDUCTION COIL MAGNETOMETERS CAN BE DESIGNED TO HAVE COMPARABLE SENSITIVITY. THESE MAGNETOMETERS CAN BE OPERATED OVER THE FREQUENCY BAND OF 0-1 KHz. USING AN ARRAY OF SUCH SENSORS, IT IS POSSIBLE TO MEASURE THE MAGNETIC FIELD VARIATIONS NEAR THE GROUND. THESE DATA CAN BE INVERTED TO OBTAIN INFORMATION REGARDING THE PRESENCE OR MOVEMENTS OF AN ELECTRICAL OR MAGNETIC OBJECT.

CERAMATEC INC  
2425 - S 9TH W  
SALT LAKE CITY, UT 84119  
CONTRACT NUMBER:  
DR SUDHIR R KULKARNI  
TITLE:  
NOVEL MATERIALS FOR HIGH CURRENT SWITCH APPLICATIONS  
TOPIC# 24a                      OFFICE: TALRPO

IF A SERIES OF MATERIALS CAN BE ENGINEERED HAVING METAL TO INSULATOR OR METAL-TO-SEMICONDUCTOR TRANSITION AT A SPECIFIC DESIRED TEMPERATURE, THEN THESE MATERIALS WILL PAVE THE WAY FOR A VARIETY OF APPLICATIONS. ONE SUCH APPLICATION IS A HIGH CURRENT, SOLID STATE, RELIABLE SWITCH. IT IS PROPOSED TO DEVELOP SUCH MATERIALS USING TiO<sub>2</sub>-VO<sub>2</sub> SOLID SOLUTION. THE HIGH TEMPERATURE RUTILE STRUCTURE OF VO<sub>2</sub> IS PROPOSED TO BE STABILIZED BY TiO<sub>2</sub> AND THUS ENGINEER THE PHASE CHANGE IN VO<sub>2</sub> AT THE DESIRED TEMPERATURE. VO<sub>2</sub> IS KNOWN TO HAVE METAL TO INSULATOR TRANSITION FO 341K. IN THIS PROGRAM, ATTEMPTS WILL BE MADE TO REDUCE THE TRANSITION TEMPERATURE OF PURE VO<sub>2</sub> BY CONTROLLED ADDITIONS OF TiO<sub>2</sub>, YET MAINTAIN THE 5 ORDERS OF MAGNITUDE CONDUCTIVITY CHANGE AT THE TRANSITION TEMPERATURE. IT IS ANTICIPATED THAT A RANGE OF DOPED VO<sub>2</sub> COMPOSITION WILL RESULT, EACH WITH THE TRANSITION AT A DIFFERENT TEMPERATURE BETWEEN 0 AND 200 DEG C. SOLID STATE SWITCHES CAN THEN BE FABRICATED FOR SPECIFIC TEMPERATURES.

CHIRP CORP  
8248 SUGARMAN DR  
LA JOLLA, CA 92037  
CONTRACT NUMBER:  
DR RICHARD A ATLES  
TITLE:  
APPLICATION OF THE DARPA ADAPT PROCESSOR TO KNOWLEDGE-SYSTEMS  
TOPIC# 12a                      OFFICE: TALRPO

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THE DARPA ADAPT PROCESSOR IS A NEURAL NETWORK SIMULATION THAT CAN IMPLEMENT MUTUAL INTERACTIONS BETWEEN A LARGE NUMBER OF PROCESSING ELEMENT VIA ADAPTIVE, PROGRAMMABLE WEIGHTING FUNCTIONS. THE PROCESSOR WAS DESIGNED PRIMARILY AS A MEANS TO SIMULTANEOUSLY CORRELATE MANY DIFFERENT TEMPLATES WITH A SET OF FEATURES EXTRACTED FROM DATA. IT WOULD SEEM, HOWEVER, THAT THE SAME ARCHITECTURE CAN BE USED FOR KNOWLEDGE-BASED EXPERT SYSTEMS (KBES'S). THE ADAPT PROCESSOR MAY BE EXTREMELY VALUABLE FOR AI APPLICATIONS, SINCE MANY DIFFERENT RELATIONS AND INFERENCES COULD BE IMPLEMENTED SIMULTANEOUSLY AT EACH TIME INCREMENT. THE NEED TO APPLY RULES TO A LARGE NUMBER OF INFERRED AND OBSERVED FACTS HAS SLOWED SOME KBES'S TO THE POINT WHERE THEY ARE INEFFECTIVE. THIS COMPUTATIONAL BOTTLENECK MAY BE AVOIDED THROUGH THE USE OF THE ADAPT PROCESSOR. PAY-OFFS INCLUDE SYSTEMS THAT CAN MAKE HYPOTHESES AS THEY GATHER DATA, AND THAT CAN CONTROL MULTI-SENSOR DATA GATHERING SO AS TO VERIFY OR REJECT THESE HYPOTHESES IN REAL TIME.

COMPUTER COGNITION

6696 MESA RIDGE RD - STE A

SAN DIEGO, CA 92121

CONTRACT NUMBER:

DRS P COKER/E PARKER

TITLE:

FEASIBILITY OF UTILIZING HIGH LEVEL KNOWLEDGE TO AID S  
RECOGNITION IN CONTEXT ACTIVATED DEVICES

TOPIC# 17a                      OFFICE: TALRPO

MOST AI SYSTEMS CURRENTLY BEING DEVELOPED WILL BENEFIT FROM SPEECH RECOGNITION CAPABILITIES. SOME ARCHITECTURES BEING CONSIDERED ARE BETTER SUITED THAN OTHERS TO PERMIT THE UTILIZATION OF "HIGHER-LEVEL" KNOWLEDGE TO IMPROVE SPEECH RECOGNITION QUALITY OR EFFICIENCY. ONE SUITABLE ARCHITECTURE IS THE CONTEXT ACTIVATED MEMORY DEVICE (CAMD, PATENT PENDING). THE PROPOSED RESEARCH WILL INVESTIGATE WAYS IN WHICH THE DIFFERENT KNOWLEDGE SOURCES OF THIS ARCHITECTURE CAN BE INCORPORATED IN A SPEECH RECOGNITION COMPONENT. ONE PROJECT GOAL IS TO ESTABLISH THE FEASIBILITY OF INCORPORATING A SPEECH RECOGNITION SYSTEM ALREADY UNDER DEVELOPMENT AS A FRONT END TO THE EXISTING DEVICE, OR MORE LIKELY, TO IDENTIFY SYSTEMS IN THE DEVELOPMENT STAGE THAT CAN MAKE USE OF KNOWLEDGE AS IT IS REPRESENTED IN THE CAMD. THIS STUDY

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WILL DETERMINE HOW MODIFIABLE THOSE SYSTEMS ARE IN TERMS OF THE CONTROL STRATEGIES USED IN CONTINUOUS WORD RECOGNITION. IT IS BELIEVED THAT IF EFFICIENT USE IS TO BE MADE OF THE CAMD (OR SIMILAR AI SYSTEM) KNOWLEDGE SOURCES IN THE SPEECH RECOGNITION PROCESS, THEN STRATEGIES MUST BE PROVIDED TO GUIDE THE APPLICATION OF THIS KNOWLEDGE. BASED ON THE WORK OF NUMEROUS INVESTIGATORS WHO HAVE ALREADY STUDIED THE USE OF PROSODY IN HUMAN SPEECH RECOGNITION, IT IS EXPECTED THAT PROSODIC AIDS TO SPEECH RECOGNITION MAY SERVE THIS PURPOSE. SEVERAL WAYS IN WHICH PROSODIC AIDS MIGHT BE USED TO GUIDE THE APPLICATION OF THE HIGHER LEVEL KNOWLEDGE ARE IDENTIFIED AND PROPOSED RESEARCH WILL ASSESS THEIR USEFULNESS IN SPEECH RECOGNITION SYSTEMS. THE FEASIBILITY OF USING PROSODIC AIDS IN THIS WAY IS ASSESSED WITH RESPECT TO THE RELIABILITY OF THESE CUES UNDER VARIOUS CONDITIONS RELEVANT TO THE USE OF KNOWLEDGE-BASED SYSTEMS. CONDITIONS UNDER CONSIDERATION INCLUDE SURROUNDING SIGNAL CONTEXT (OR NOISE), LINGUISTIC CONSTRAINTS, CHUNK SIZE, AND MEMORY ENSEMBLE.

CONCEPT ENGINEERING

2077 DIKE RD

MOUNT VERNON, WA 98273

CONTRACT NUMBER:

JOHN A WEBSTER

TITLE:

HELMET-MOUNTED STEREOSCOPIC FULL FIELD OF VISION VIDEO

USE IN REAL TIME OR COMPUTER SIMULATED VIEWING SYSTEMS

TOPIC# 3a

OFFICE: TALRPO

THIS PROPOSED FULL FIELD OF VISION STEREOSCOPIC VIDEO SYSTEM DIFFERS SIGNIFICANTLY FROM ALL PREVIOUS STEREOSCOPIC VIDEO SYSTEMS IN TWO WAYS. FIRST; THE FIELD OF VIEW (FOV) PRESENTED TO THE VIEWER WILL BE AN UNDISTORTED 240 DEGREES HORIZONTAL AND 120 DEGREES VERTICAL OCCUPYING THE TOTAL VISUAL INPUT AVAILABLE TO THE OPERATOR AND, SECOND; WILL INCLUDE ALL ASPECTS OF VISUAL PERCEPTION EXCEPT ACCOMMODATION. THESE ARE ACCOMPLISHED BY A PROPRIETARY METHOD. THE PROPOSED SYSTEM WILL SUBSTITUTE A REMOTE SENSOR AND A VIDEO DISPLAY FOR THE ENTIRE VISUAL REALITY OF THE OPERATOR, THEREBY GREATLY ENHANCING THE OPERATOR'S VIDEO MEDIATED PERCEPTION. AN OPERATOR THAT HAS THE WHOLE PICTURE WITHOUT OUTSIDE INFLUENCES, DISTRACTIONS, AND BIASES WILL BE ABLE TO MORE ACCURATELY PERFORM ALL THE POSSIBLE FUNCTIONS OF ANY REMOTELY

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OPERATED, OR SIMULATED, SYSTEM AS IF HE WERE THERE.

CORDEC CORP  
8270-B CINDER BED RD  
LORTON, VA 22079  
CONTRACT NUMBER:  
DR RAYMOND J WEIMER  
TITLE:  
HIGH TEMPERATURE METAL MATRIX COMPOSITES FOR HYPERSONIC  
STRUCTURES  
TOPIC# 5a                      OFFICE: TALPO

THE NATIONAL AERO-SPACE PLANE (NASP) PROGRAM WILL DEVELOP MANNED HYPERSONIC AIRPLANES (MACH 6-25) THAT WILL PROVIDE ORBIT-ON-DEMAND CAPABILITY FROM CONVENTIONAL RUNWAYS, THEREBY REVOLUTIONIZING ACCESS TO SPACE. HOWEVER, SUCCESS WILL DEPEND UPON THE DEVELOPMENT OF NEW, LIGHT-WEIGHT STRUCTURAL MATERIALS HAVING UNPRECEDENTED HIGH-TEMPERATURE PERFORMANCE CAPABILITIES. VERY ATTRACTIVE NEAR-TERM CANDIDATES ARE LOW-DENSITY HIGH-TEMPERATURE METAL MATRICES REINFORCED WITH CONTINUOUS HIGH-PERFORMANCE CERAMIC OR GRAPHITE FIBERS. SUCH COMPOSITES ARE EXPECTED TO EXHIBIT GOOD MECHANICAL PROPERTIES AT TEMPERATURES IN EXCESS OF 1000C. IN THE PROPOSED WORK, NEWLY DEVELOPED PRECURSOR FABRICATION TECHNOLOGY WILL BE UTILIZED TO MANUFACTURE ULTRA-THIN METAL MATRIX COMPOSITE TAPES LESS THAN 0.001 INCH THICK. CONSOLIDATION PROCEDURES WILL BE DEVELOPED FOR PRODUCING THIN, MULTI-PLY PANELS FROM 0.010 TO 0.060 INCH THICK IN UNIDIRECTIONAL, ORTHOTROPIC, AND QUASI-ISOTROPIC LAYUPS. PRELIMINARY CHARACTERIZATION OF STRUCTURES AND PROPERTIES WILL BE USED TO FORMULATE A PHASE II OPTIMIZATION PROGRAM THAT WILL INCLUDE FABRICATION OF PROTOTYPE STRUCTURES SUCH AS HONEYCOMB PANELS AND THIN-WALLED TUBES FOR EVALUATION OF MECHANICAL BEHAVIOR AND OXIDATION AT ELEVATED TEMPERATURES.

DEACON RESEARCH  
900 WELCH RD - STE 203  
PALO ALTO, CA 94304  
CONTRACT NUMBER:  
DAVID A G DEACON  
TITLE:  
TRANSONIC FLOW FIELD MEASUREMENT SCHEME DEVELOPMENT  
TOPIC# 6a                      OFFICE: TALRPO

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LITTLE INSTRUMENTATION IS AVAILABLE TO MEASURE THE FLOW PARAMETERS OF TRANSONIC OR SUPERSONIC FLOWS IN WIND TUNNELS OR COMBUSTION CHAMBERS. COMMERCIAL LASER DOPPLER VELOCIMETERS BECOME INCREASINGLY INACCURATE FOR HIGH MACH NUMBERS BECAUSE THEY RELY ON SCATTERING FROM LARGE PARTICLES WHICH CANNOT FOLLOW THE FLOW THROUGH TURBULENCE OR SHOCKS. THE TESTING OF TRANSONIC AIRFOILS OR SCRAMJET ENGINES REQUIRES VELOCITY, DENSITY, AND TEMPERATURE INFORMATION FOR THE FLOW WHICH CAN BE OBTAINED THROUGH THE APPLICATION OF LASER INDUCED FLUORESCENCE TECHNIQUES WHICH INTERROGATE THE MOLECULES OF THE FLOW ITSELF. SOME OF THESE TECHNIQUES HAVE BEEN DEVELOPED TO AN ADVANCED STATE IN RESEARCH LABORATORIES. IT IS ALSO POSSIBLE TO OBTAIN SIMULTANEOUS MEASUREMENTS OF TWO FLOW PARAMETERS SUCH AS VELOCITY AND TEMPERATURE (REQUIRED FOR THE SOLUTION OF THE TIME-AVERAGED NAVIER-STOKES EQUATIONS). WE PROPOSE TO SELECT A TARGET MOLECULE AND PERFORM A CONCEPTUAL DESIGN STUDY FOR A SYSTEM WHICH PROVIDES AN OPTIMUM CAPABILITY FOR MEASURING THE VELOCITY, DENSITY, AND TEMPERATURE IN THE TRANSONIC REGION FOR AIRFOIL AND SCRAMJET TESTING. IN THE PHASE II EFFORT, WE WOULD DEVELOP THIS DESIGN INTO A PROTOTYPE INSTRUMENT AND BEGIN INITIAL TESTING IN AN AIRFLOW.

DISPLAYTECH INC  
2200 CENTRAL AVE - STE C  
BOULDER, CO 80301  
CONTRACT NUMBER:  
MARK HANDSCHY  
TITLE:  
OPTICAL INTERCONNECTION TECHNIQUES USING FERROELECTRIC CRYSTALS  
TOPIC# 11a                      OFFICE: TALPRO

THE PROPOSED PROJECT AIMS TO EXPLOIT THE HIGH-SPEED ELECTRO-OPTIC PROPERTIES OF FERROELECTRIC LIQUID CRYSTALS (FLCs) TO MAKE OPTICAL CROSSBAR SWITCHES. THESE SWITCHES WOULD ALLOW LARGE NUMBERS (HUNDREDS TO THOUSANDS) OF INPUT LIGHT BEAMS MODULATED AT GHz RATES TO BE CONNECTED IN ANY POSSIBLE ONE-TO-ONE PATTERN TO AN EQUALLY LARGE NUMBER OF OUTPUTS. THE PROPOSED SWITCH GEOMETRIES PROMISE THAT ONLY A SMALL (102 dB) AMOUNT OF LIGHT WOULD BE LOST BETWEEN INPUT AND OUTPUT. THE FAST SWITCHING CHARACTERISTIC OF FLCs ALLOW THE ENTIRE CONNECTION PATTERN OF THE SWITCH TO BE RECONFIGURED IN MICROSECOND TO SUBMICRO-

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SECOND TIMES WITH ENERGY DISSIPATIONS OF ONLY PICOJOULES. THE LOW-POWER, LOW-VOLTAGE BISTABLE SWITCHING CHARACTERISTICS OF FLCs MAKE EITHER ELECTRICAL OR OPTICAL ADDRESSING EQUALLY FEASIBLE. THE PROPOSED N X N CROSSBAR SWITCHES WILL BE MADE UP OF ON THE ORDER OF N<sup>2</sup> INDIVIDUAL SWITCHING ELEMENTS FABRICATED ON A SINGLE SUBSTRATE. PHASE I OF THE PROPOSED EFFORT WILL SELECT AN APPROPRIATE GEOMETRY, DESIGN, FABRICATE, AND TEST AN INDIVIDUAL "PROOF-OF-CONCEPT" SWITCH ELEMENT. DURING PHASE II, COMPLETE MULTI-LINE CROSSBAR SWITCHES WILL BE DESIGNED AND FABRICATED.

DYNAMIC ANALYSIS & TESTING ASSOCS  
766 SECOND ST  
ENCINITAS, CA 92024  
CONTRACT NUMBER:  
C THOMAS SAVELL  
TITLE:  
87-06: RADAR CROSS SECTION CALCULATIONS  
TOPIC# 4a OFFICE: TALRPO

IN PHASE I, A STUDY TO THIS PROPOSAL DESCRIBES A STUDY TO ESTABLISH TECHNICAL MERIT AND FEASIBILITY OF EXPANDING THE CURRENT SOLID MODELING VISUALIZATION ALGORITHMS, USED IN VIEWING OBJECTS ILLUMINATED BY LIGHT, TO VIEWING OBJECTS REPRESENTED BY THEIR UHF FREQUENCY RADIATION AND SCATTERING. THIS WOULD ALLOW A DISPLAY OF THE 3D RADAR CROSS SECTION WITH COLOR GRAPHICS REPRESENTING DIFFERING INTENSITY AND ELECTROMAGNETIC PROPERTIES. THE STUDY WOULD IDENTIFY THE IMPLEMENTATION SPECIFICATIONS OF REQUIRED SOFTWARE TO INCORPORATION OF MICROWAVE SPECTRA ELECTROMAGNETIC SOURCE; DEVELOP MORE EFFECTIVE BOUNDING METHODS FOR CALCULATING THE RAY-SURFACE INTERSECTION; IMPROVED BICUBIC SURFACE PATCHES; UHF REGIME BIDIRECTIONAL REFLECTANCE SURFACE COEFFICIENTS; SIMULATION OF A TIME DOMAIN PULSE STRIKE; CALCULATION AND DISPLAY OF THE BISTATIC SCATTERING MATRIX FOR OBLIQUE INCIDENCE. IN PHASE II THE DESIGN AND SPECIFICATIONS CREATED IN PHASE I WILL BE USED TO DEVELOP A DEDICATED MICRO (PC) OR MINICOMPUTER (80386, SUN, APOLLON OR MICROVAX) WORKSTATION FOR THE INTERACTIVE MODELING AND DISPLAY OF 3D RADAR CROSS SECTIONS OF TARGETS.

FIBER MATERIALS INC  
BIDDEFORD INDUSTRIAL PK  
BIDDEFORD, ME 04405  
CONTRACT NUMBER:  
JAMES C FEDUSKA  
TITLE:  
COMPARISON AND EVALUATION OF GAS ANALYZERS AS IN-PROCE  
FOR THE INTELLIGENT PROCESSING OF CARBON/CARBON COMPOS  
TOPIC# 10a OFFICE: TALRPO

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CARBON/CARBON COMPOSITES ARE HIGH STRENGTH MATERIALS WHICH WILL BE INCREASINGLY USED IN ADVANCED AEROSPACE AND DEFENSE SYSTEMS. AS MATERIAL PERFORMANCE REQUIREMENTS BECOME MORE STRINGENT, THE CURRENT PROCESS CONTROL METHODS WILL BECOME INADEQUATE AND MANUFACTURING VARIABILITIES WILL IMPACT ON SYSTEM PERFORMANCE, COST AND RELIABILITY. CURRENT MANUFACTURING SYSTEMS RELY HEAVILY ON TEMPERATURE AND PRESSURE SENSORS AS PRIMARY MEANS OF CONTROLLING THE FINAL MATERIAL PROPERTIES. MORE ATTENTION SHOULD BE PAID TO THE CHEMICAL AND PHYSICAL CHANGES WHICH ARE OCCURRING IN-PROCESS. ADVANCED CONTROL SYSTEMS MUST MONITOR THESE CHANGES WITH APPROPRIATE SENSORS AND PROVIDE A MEANS VIA AN INTELLIGENT PROCESSOR OF ADJUSTING THE PROCESS TO OBTAIN LESS PRODUCT VARIABILITY AND DESIRED PROPERTIES. CARBONIZATION IS A KEY PROCESS STEP USED IN C/C MANUFACTURING. AN INHERENT FEATURE OF PITCH MATRIX PRECURSORS IS MESOPHASE FORMATION, WHICH IS A DISPERSED PHASE FORMED BY THE CHEMICAL REACTION OF SELECT COMPONENTS IN THE PITCH. MESOPHASE FORMATION AND COALESCENCE ARE ESSENTIAL TO THE FORMATION OF GRAPHITIC MATRIX MICROSTRUCTURE. THUS, IMPROVED CONTROL OF THIS STEP MAY LEAD TO INCREASED COMPOSITE PERFORMANCE AND DECREASED VARIABILITY. GAS EVOLUTION, DUE TO CHEMICAL REACTION, ALSO OCCURS DURING THE CARBONIZATION PROCESS. THUS, IN SITU GAS ANALYZERS COULD BE USED AS CARBONIZATION PROCESS SENSORS.

FLAM & RUSSELL INC  
PO BOX 444

HORSHAM, PA 19044

CONTRACT NUMBER:

S TAYLOR ADAIR

TITLE:

APPLICATION OF EXPERT SYSTEM TECHNOLOGY TO THE FIELD V  
OF MEASURED RCS DATA

TOPIC# 7a

OFFICE: TALRPO

HUMAN EXPERTS IN THE FIELD OF RADAR CROSS SECTION (RCS) DATA ANALYSIS ARE SCARCE AND IN HIGH DEMAND, AS ARE THE FACILITIES REQUIRED TO MAKE SUCH MEASUREMENTS. IN ADDITION, THESE FACILITIES ARE VERY EXPENSIVE TO OPERATE AND MANY ARE LOCATED IN REMOTE AREAS WHERE IT MAY BE IMPRACTICAL TO POST A FULL-TIME HUMAN EXPERT. A MEANS OF AUTOMATICALLY VALIDATING THE TEST DATA COLLECTED AT THESE FACILITIES WOULD: 1) REDUCE RE-TEST TIME AND COST, AND 2) RELIEVE HUMAN EXPERTS OF THIS



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TASK. AN INVESTIGATION INTO THE FEASIBILITY OF APPLYING "ARTIFICIAL INTELLIGENCE", AND IN PARTICULAR "EXPERT SYSTEM", TECHNOLOGY TO BUILD SUCH A CAPABILITY IS PROPOSED.

FLOW RESEARCH CO  
21414 - 68TH AVE S  
KENT, WA 98032  
CONTRACT NUMBER:  
DR G STUART KNOKE  
TITLE:  
INNOVATIVE SCRAMJET FLAMEHOLDERS FOR ENHANCED MIXING  
TOPIC# 5a                      OFFICE: TALRPO

AN EXPERIMENTAL INVESTIGATION OF INNOVATIVE FLAMEHOLDER DESIGNS TO ENHANCE MIXING IN A SUPERSONIC COMBUSTION RAMJET (SCRAMJET) ENGINE IS PROPOSED. IN A SCRAMJET ENGINE OPERATING AT HYPERSONIC FLIGHT SPEEDS, THE SHORTER RESIDENCE TIME AND DECREASED MIXING RATE CAUSE DETERIORATION IN THE COMBUSTION EFFICIENCY AS COMPARED WITH LOWER SPEEDS. TWO CONFIGURATIONS RECENTLY DEVELOPED TO PROMOTE RAPID MIXING FOR SUBSONIC FLOWS WILL BE TESTED IN A SUPERSONIC FLOW AND EXPERIMENTALLY COMPARED WITH A BASELINE CONVENTIONAL CONFIGURATION. THE TWO CONFIGURATIONS ARE A MULTIPLE-STEP FLAMEHOLDER AND A THREE-DIMENSIONAL "TOOTHED" STEP FLAMEHOLDER. THE OBJECTIVE OF THIS STUDY IS TO EVALUATE THE CONFIGURATIONS, OR COMBINATIONS OF THEM, AS A MEANS OF RAPID AND THOROUGH MIXING OF THE FUEL WITH THE SUPERSONIC AIR STREAM. DURING PHASE I, THE FEASIBILITY OF THESE SCRAMJET MIXING CONCEPTS WILL BE DETERMINED. PHASE I WILL INVOLVE AN EXPERIMENTAL STUDY OF THE CONFIGURATIONS USING A FACILITY SIMILAR TO A BLOW-DOWN WIND TUNNEL. WE PLAN TO MIX HELIUM WITH NITROGEN AND MEASURE THE CONCENTRATION PROFILE AT A SUITABLE DISTANCE DOWNSTREAM OF THE STEP. IT IS EXPECTED THAT THE NEW MIXING CONFIGURATIONS WILL ALLOW THE HELIUM TO DIFFUSE MORE RAPIDLY ACROSS THE SUPERSONIC NITROGEN FLOW. WITH FAVORABLE RESULTS IN PHASE I, A PHASE II RESEARCH AND DEVELOPMENT PROGRAM WILL BE PURSUED TO PROVIDE PARAMETRIC INFORMATION FOR DESIGN OPTIMIZATION.

FOSTER-MILLER INC  
350 SECOND AVE  
WALTHAM, MA 02254  
CONTRACT NUMBER:  
ALAN J LANE  
TITLE:  
REMOTELY OPERATED MINE DETECTION SYSTEM  
TOPIC# 25a                      OFFICE: TALRPO

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THE CAPABILITY EXISTS TO DETECT MAGNETIC, NONMAGNETIC, METALLIC AND PLASTIC BURIED AND SURFACE SCATTERED MINES THROUGH THE USE OF A SIMPLE SUITE OF SENSORS FROM THE SURFACE. THE CAPABILITY ALSO EXISTS TO DESIGN, BUILD, AND OPERATE A LOW COST REMOTE CONTROLLED PLATFORM FOR CARRYING THIS SUITE OF SENSORS. BOTH TECHNOLOGIES ARE CURRENTLY UNDER DEVELOPMENT AND/OR BEING DEMONSTRATED AT FOSTER-MILLER, INC. THIS PROGRAM PROPOSES TO MARRY THE TWO TECHNOLOGIES TO PROVIDE THE CAPABILITY FOR BOTH FOOT SOLDIERS AND ARMORED CAVALRY TO DETECT BURIED MINES AT STANDOFF RANGES OF UP TO 1000 METERS. THE NOVEL ASPECTS OF THE PROPOSED DEVELOPMENT EFFORT INVOLVE THE MINIATURIZATION OF THE SENSORS AND PLATFORM AND THE CONSEQUENT REDUCTIONS IN COST. ONCE THE PRIMARY DETERMINATE OF COST MINIMIZATION IS ACHIEVED, EQUIPMENT DEVELOPED FOR COUNTERMINE PURPOSES CAN PERHAPS BE USED FOR MINE APPLICATIONS. BY SIMPLY CHANGING THE SENSOR SUITE AND PAYLOAD, REMOTELY ACTUATED OR AUTONOMOUS UNITS COULD FILL AN ANTI-ARMOR OR ANTI-FIXED TARGET ROLE.

HINES-LAB  
4525-B SAN FERNANDO RD  
GLENDALE, CA 91204  
CONTRACT NUMBER:  
STEPHEN P HINES  
TITLE:  
SPECIAL EFFECTS FOR SIMULATORS  
TOPIC# 32a      OFFICE: TALRPO

TECHNIQUES WILL BE SOUGHT TO INCREASE THE REALISM OF VISUAL CUES FOR USERS OF SIMULATORS IN BATTLEFIELD SITUATIONS. EXISTING SPECIAL EFFECTS TECHNOLOGY DEVELOPED FOR MOTION PICTURES AND THEME PARKS, AS WELL AS COMMERCIAL AIRCRAFT SIMULATORS, WILL BE EXPANDED UPON DURING PHASE I.

INNOVATIVE DYNAMICS  
1607 W FIFTH ST - VENTURA COUNTY AIRPORT  
OXNARD, CA 93030  
CONTRACT NUMBER:  
JOSEPH J GERARDI  
TITLE:  
A SOLID STATE AUTONOMOUS ICE PROTECTION SYSTEM FOR ALL  
TOPIC# 3a      OFFICE: TALRPO

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INCREASED PERFORMANCE DEMANDS BEING MADE ON RPV'S WILL SOON REQUIRE AN ALL-WEATHER ICE PROTECTION CAPABILITY. THE OBJECT OF OUR STUDY WILL BE TO APPLY UNIQUE ICING SENSOR AND ICE PROTECTION TECHNOLOGIES WHICH WERE DEVELOPED BY INNOVATIVE DYNAMICS (IDC) UNDER A RECENT NASA SBIR CONTRACT. WE HAVE SUCCESSFULLY DEICED A RPV TYPE WING SECTION LEADING EDGE DURING PRELIMINARY TESTS PERFORMED WITHIN OUR ICING RESEARCH LAB. THE SYSTEM EMPLOYED TO REMOVE ICE FROM THE RPV WING SECTION MOCK-UP IS CALLED RODIS: RESONANT OSCILLATORY DEICING SYSTEM. THIS STUDY WILL DETERMINE THE FEASIBILITY OF USING RODIS AS AN EFFECTIVE ICE PROTECTION SYSTEM FOR RPV'S, AS WELL AS A MEANS OF EMPLOYING SOLID STATE SENSORS AND ACTUATORS AS KEY RODIS SYSTEM COMPONENTS. A LAB MODEL WING SECTION WILL BE CONSTRUCTED TO DEMONSTRATE THE CLOSED LOOP (STATIC) DETECTION & REMOVAL OF GLAZE AND RIME ICE. THIS IS WILL PAVE THE WAY TOWARDS DEVELOPING AN AUTONOMOUS ICE PROTECTION SYSTEM FOR RPV'S WITH LOW-COST AND LIGHT-WEIGHT-SOLID STATE COMPONENTS.

INTERSPEC INC  
1100 E HECTOR ST  
CONSHOHOCKEN, PA 19428  
CONTRACT NUMBER:  
JENHO TSAO  
TITLE:

SAR IMAGE ENHANCEMENT TO CLEANING OUT SEA CLUTTER  
TOPIC# 28a                      OFFICE: TALRPO

THE EFFECTS OF SEA CLUTTER ON SAR IMAGES ARE VERY PRONOUNED AND IMPAIR TARGET DETECTION AND IDENTIFICATION. A TECHNIQUE CALLED CLEAN CAN BE USED TO REMOVE THE EFFECTS OF THE DISCERNIBLE WAVE PHENOMENA PRESENT IN SAR IMAGES, REDUCE SEA CLUTTER INTENSITIES AND IMPROVE TARGET DETECTION. THE PROPOSED CLEAN TECHNIQUE WILL OPERATE ON THE FOURIER TRANSFORM OF THE IMAGE TO REMOVE STRONG SPACIAL FREQUENCY COMPONENTS WHICH ARE DUE TO THE WAVE MODULATED NATURE OF SEA CLUTTER IN THE IMAGE PLANE. TARGET INTENSITY AS A FIRST APPROXIMATION WILL NOT BE REDUCED BY APPLYING CLEAN BECAUSE THE TARGET IS PHYSICALLY SMALL IN RELATION TO THE SIZE OF THE IMAGE PLANE AND WILL HAVE ITS ENERGY SPREAD IN THE SPACIAL FREQUENCY PLANE MORE THAN THE DISTRIBUTED SEA CLUTTER'S ENERGY. AFTER REMOVING THE SEA WAVE COMPONENTS FOUND IN THE IMAGE, AN INVERSE FOURIER TRANSFORM IS PERFORMED AND THE RE-

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SULT IS AN IMAGE WITH THE TARGETS UNAFFECTED AND THE SEA CLUTTER INTENSITY REDUCED. THIS WILL RESULT IN IMPROVED TARGET DETECTION AND IDENTIFICATION.

IONWERKS  
2215 ADDISON  
HOUSTON, TX 77030  
CONTRACT NUMBER:  
DR FHOWARD K SCHMIDT  
TITLE:  
APPLICATION OF VLSI TO VECTOR ACCUMULATORS AND INTEGRA  
TO DIGITAL CONVERTER  
TOPIC# 14a                      OFFICE: TALRPO

DESIGN, SIMULATION, FABRICATION, AND EVALUATION OF A PROTOTYPE VERY LARGE SCALE INTEGRATION (VLSI) DATA ACQUISITION SUBSYSTEM IS PROPOSED. AVAILABLE STATE-OF-THE-ART ONE MICRON CMOS TECHNOLOGY MAY ALLOW INCORPORATION OF MORE THAN 128 CHANNELS OF 24-BIT 300 MHz COUNTERS INTO A SINGLE INTEGRATED CIRCUIT. A PROTOTYPE SYSTEM OF SIMPLE REPEATED CELLS OF COUNTERS, CONTROL AND I/O BUFFERS HAS BEEN DESIGNED FOR THE EVALUATION OF THE FEASIBILITY OF CONSTRUCTING INTEGRATED NUCLEAR DATA SUBSYSTEMS AND PRE-PROCESSORS. THE PROTOTYPE DEVICE HAS VERSATILE CONTROL CIRCUITRY ALLOWING OPERATION AS A MULTI-CHANNEL SCALER (MCS), A ZERO DEAD-TIME INTEGRATING TIME-TO-DIGITAL CONVERTER (ITDC), OR A VECTOR ACCUMULATOR (VA). CONSTRUCTION OF SPECIFIC DATA ACQUISITION SYSTEMS IS INTENDED IN FOLLOW ON WORK AND IS DISCUSSED.

L.N.K. CORP INC  
6811 KENILWORTH AVE - STE 306  
RIVERDALE, MD 20737  
CONTRACT NUMBER:  
BARBARA A LAMBIERD  
TITLE:  
ADVANCED RADAR CROSS SECTION MEASUREMENT ANALYSIS  
TOPIC# 7a                      OFFICE: TALRPO

AUTOMATIC IDENTIFICATION OF TARGET INFORMATION USING RADAR CROSS

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SECTIONS IS AN EXTREMELY DIFFICULT PROBLEM. A LARGE AMOUNT OF EFFORT HAS BEEN DEVOTED TO THE PROBLEM OF ESTIMATING THE RADAR CROSS SECTION OF VARIOUS SHAPES, BUT THE RANGE OF POSSIBLE OBJECTS WHICH CAN BE ENCOUNTERED IS LARGE, AND MEASURES CAN BE TAKEN TO ALTER THE APPEARANCE OF A RADAR CROSS-SECTION. IN ADDITION, AN OBJECT CAN BE VIEWED FROM MANY VIEWPOINTS, ADDING TO THE COMPLEXITY OF THE ANALYSIS TASK. IDENTIFICATION OF "HOT SPOTS" USING RADAR CROSS SECTIONS IS USEFUL FOR BOTH TARGET RECOGNITION AND FOR COUNTERMEASURE PURPOSES. WE ARE PROPOSING TO STUDY THE APPLICABILITY OF SEVERAL RELATED AND COMPLEMENTARY ARTIFICIAL INTELLIGENCE APPROACHES FOR THE ANALYSIS OF RADAR CROSS SECTIONS. ONE TECHNIQUE OPERATES PRIMARILY IN THE FREQUENCY DOMAIN AND THE OTHER MAINLY IN THE SPATIAL DOMAIN. WE WILL EVALUATE THESE TECHNIQUES AND EXPLORE THE POSSIBILITY OF COMBINING THEM TO ACHIEVE A ROBUST MULTI-DOMAIN ANALYSIS TOOL. THE TECHNIQUES BEING STUDIED HAVE ALREADY PROVEN USEFUL IN A VARIETY OF DOMAINS INCLUDING SPEECH, MEDICAL WAVEFORM ANALYSIS, AND IMAGE ANALYSIS.

MACROMOLECULAR MATERIAL INC

2770 WESTMOOR RD

ROCKY RIVER, OH 44116

CONTRACT NUMBER:

DR LI-CHEN HSU

TITLE:

ANALYSIS OF THERMAL AND SHOCK REDUCTION OF GRAPHITE FI

TSTR POLYIMIDE COMPOSITE MECHANICAL PROPERTIES

TOPIC# 16a OFFICE: TALRPO

HIGHLY THERMO-STABLE AND SHOCK-RESISTANT GRAPHITE FIBER COMPOSITES ARE PREPARED FROM TSTR (TRIARYL-S-TRIAZINE RING) POLYIMIDE HAVING A LINEAR RING-CHAIN STRUCTURE AS DESCRIBED IN HUS: U.S. PATENT 4,555,565-NOV. 26, 1985. PRELIMINARY EVALUATION OF THEIR MECHANICAL PROPERTIES RELEVANT TO THERMAL AND SHOCK REDUCTION WILL BE PERFORMED UNDER BOTH STATIC AND DYNAMIC (INFRA-RED BEAM) LOADS AT ELEVATED TEMPERATURES OF 700, 1400, AND 2100 DEG F. THE TEST RESULTS SHOULD SERVE FOR SENSITIVITY ANALYSIS OF MATERIALS PARAMETERS AND FOR TRIAL COMPOSITIONS IN COMBINED (THERMAL/SHOCK) HARDENED STRUCTURES DEVELOPMENT.

MARTINGALE RESEARCH CORP

100 ALLENTOWN PKWY - STE 211

ALLEN, TX 75002

CONTRACT NUMBER:

DR ROBERT L DAWES

TITLE:

NEURAL NETWORKS FOR ADAPTIVE THREAT RESPONSE

TOPIC# 12a OFFICE: TALRPO

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NEURAL NETWORKS ARE A PROMISING SOLUTION TO SEVERAL PROBLEMS IN THE APPLICATION OF PARALLEL PROCESSING TECHNOLOGY FOR ADAPTIVE RECOGNITION AND RESPONSE TO COMPLEX PATTERNS. UNFORTUNATELY, IT IS NOT KNOWN HOW TO GET A NEURAL NETWORK TO RECOGNIZE PATTERNS INDEPENDENTLY OF THE VALUES OF THEIR FEATURE PARAMETERS WITHOUT INCORPORATING SPECIAL INVARIANT TRANSFORMS FOR EACH SUCH FEATURE. THIS PROPOSAL INTRODUCES THE CONCEPT OF THE "PARAMETRIC AVALANCHE", WHICH DESCRIBES HOW A NEURAL NETWORK CAN ASSOCIATE PATTERNS THROUGH THE ACTIVATION OF FEATURE PATHWAYS OTHER THAN SIMPLE TIME PROXIMITY. THROUGH THIS MECHANISM, WE DESCRIBE NOT ONLY HOW TO MEASURE THE TRAJECTORY OF AN OBJECT, BUT ALSO HOW TO EXTRAPOLATE THE TRAJECTORY AND GUIDE A COUNTERMEASURE TO INTERCEPT THE TARGET.

MATRONIX INC  
2066 N OAK LN  
STATE COLLEGE, PA 16803  
CONTRACT NUMBER:  
IN-MYUNG CHUNG  
TITLE:  
NOVEL CONDUCTING CERAMIC/POLYMER COMPOSITE PTC THERMIS  
HIGH CURRENT SWITCHES  
TOPIC# 24a      OFFICE: TALRPO

RESEARCH ON UTILIZING CLASSIFIED CONDUCTING CERAMIC POWDERS SUCH AS TiC, TiB2 AND ZrB2, AND THE CONCEPT OF PERCOLATION AND SUBSEQUENT PTC EFFECTS, TO FABRICATE CERAMIC/POLYMER COMPOSITE THERMISTERS FOR HIGH CURRENT SWITCHES IS HEREIN PROPOSED. THE USE OF VERY CONDUCTING POWDERS AND OPTIMIZED PARTICLE SIZE(S) AND DISTRIBUTIONS OF SUCH, SHOULD ENABLE THE DEVELOPMENT OF VERY LOW RESISTIVITY (1 OHM-CM) COMPOSITE THERMISTORS. THE OPTIMIZED COMPOSITE DESIGN WILL THUS ENABLE THE CAPABILITY OF DEALING WITH CURRENT DENSITIES AS HIGH AS 10000 AMPS/SQ.CM IN THEIR CONDUCTIVE STATE. THIS COMPOSITE MATERIAL ADVANCE SHOULD MEET THE NECESSARY REQUIREMENTS OF ELECTRICAL PULSED POWER DEVICES BEING DEVELOPED FOR VARIOUS WEAPON APPLICATIONS.

MICRILOR INC  
NINE LARKESIDE OFFICE PK  
WAKEFIELD, MA 01880  
CONTRACT NUMBER:  
DR IWEN YAO  
TITLE:  
REAL-TIME HYBRID IMAGE PROCESSOR FOR SYNTHETIC APERTUR  
TOPIC# 27a      OFFICE: TALRPO

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PROCESSING OF SYNTHETIC APERTURE RADAR (SAR) DATA IS ESSENTIALLY A TWO DIMENSIONAL CORRELATION PROCESS. BECAUSE OF THE RANGE-WALK AND RANGE-CURVATURE PROBLEMS, THE ALGORITHM USED IS USUALLY COMPLICATED IN AN EFFORT TO CORRECT THESE EFFECTS. NEVERTHELESS THE MAIN DIFFICULTY OF REAL-TIME SAR PROCESSING IS STILL IN THE SHEAR VOLUME OF DATA WHICH DEMANDS EXTREMELY LARGE COMPUTATION CAPACITY. SINCE THE CROSS-RANGE PHASE HISTORY OF A POINT TARGET IS ESSENTIALLY LINEAR FM AND THE LINEAR FM WAVEFORM IS ALSO COMMONLY USED FOR RANGE COMPRESSION, A DISPERSIVE DELAY LINE (DDL) IS IDEALLY SUITED FOR SAR PROCESSING NOT ONLY IN RANGE BUT ALSO IN CROSS-RANGE DIRECTIONS. THE WORK PROPOSED HEREIN WOULD DEVELOP A HYBRID DDL/DIGITAL PROCESSOR FOR REAL-TIME SAR PROCESSING UTILIZING CURRENT, COMMERCIALY AVAILABLE, TECHNOLOGIES.

MISSION RESEARCH CORP  
1720 RANDOLPH RD SE  
ALBUQUERQUE, NM 87106  
CONTRACT NUMBER:  
BRENDAN GODFREY  
TITLE:  
ELECTRON BEAM STABILITY IN COMPACT RECIRCULATING ACCEL  
TOPIC# 9a                      OFFICE: TALRPO

STABLE BEAM TRANSPORT IS A CENTRAL ISSUE IN DEVELOPING COMPACT HIGH CURRENT ELECTRON BEAM RECIRCULATING INDUCTION ACCELERATORS. POTENTIALLY DANGEROUS INSTABILITIES INCLUDE THE NEGATIVE MASS, THE BEAM BREAKUP (FOR INDUCTIVE GAPS DESIGNS), AND THREE-WAVE (FOR STRONG FOCUSING DESIGNS). MISSION RESEARCH CORPORATION PROPOSES TO DETERMINE THEIR SERIOUSNESS FOR HIGH CURRENT RECIRCULATING ACCELERATORS AND TO ESTABLISH BEAM AND ACCELERATOR PARAMETERS WHICH MINIMIZE THEIR DISRUPTIVENESS. EMPHASIS WILL BE PLACED ON SPIRAL LINE DEVICES, ALTHOUGH THE RESULTS OBTAINED WILL BE APPLICABLE MORE GENERALLY. SPECIFIC PHASE I ACTIVITIES ARE (1) GENERALIZING AN EXISTING BEAM BREAKUP INSTABILITY COMPUTER CODE TO TREAT PROPERLY THE OVERLAPPING RESONANT MODES OF A VERY LOW Q CAVITIES AND THEN EMPLOYING THIS CODE TO OBTAIN BETTER PREDICTIONS OF BEAM BREAKUP GROWTH IN THE SPIRAL LINE ACCELERATOR, (2) DETERMINING THE GROWTH RATES OF THE NEGATIVE MASS INSTABILITY AT HIGH MODE NUMBERS, WHERE ELECTROMAGNETIC RESONANCES ARE IMPORTANT, AND (3) ASSESSING PROPOSED METHODS OF SUPPRESSING

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THREE-WAVE INSTABILITIES.

MSDA ASSOCS (dba MYERS LABS)  
20 S SANTA CRUZ AVE - STE 308  
LOS GATOS, CA 95030

CONTRACT NUMBER:

PETER H MYERS

TITLE:

SPATIAL DIGITAL AUDIO AS USED FOR SPECIAL EFFECTS FOR  
TOPIC# 32a OFFICE: TALRPO

MYERS LABORATORIES HAS DEVELOPED A THREE-DIMENSIONAL, AUDITORY DISPLAY TECHNOLOGY THAT UTILIZES THE HUMAN AUDITORY SYSTEM'S ABILITY TO LOCALIZE THE DIRECTION AND DISTANCE OF A SOUND SOURCE. THE TECHNOLOGY MIMICS THE HUMAN AUDITORY LOCALIZATION SYSTEM, BY COMPUTER EMULATION OF THE NATURAL BINAURAL AUDITORY SIGNAL PROCESSING (BIONIC EMULATION). AN OUTGROWTH OF THE TECHNOLOGY HAS BEEN THE RESEARCH INTO THE USE OF SUBAUDIBLE SOUND (INFRASONIC SOUND) AS A MEANS TO BOTH BROADEN THE EFFECTIVENESS OF THREE-DIMENSIONAL AUDITORY DISPLAYS AND PROVIDE OTHER COMPLEX SITUATION INFORMATION. AS A RESULT, THE TECHNOLOGY WILL DRAMATICALLY IMPROVE OPERATOR TO COMPLEX SYSTEM INTER-FACE BY PROVIDING AN EFFECTIVE ALTERNATIVE MEANS OF INFORMATION TRANSFER TO THE BRAIN IN A MANNER THAT BOTH AUGMENTS AND COMPLEMENTS THE OPERATOR'S VISUAL PERCEPTION SYSTEM. THIS IS PARTICULARLY TRUE IN SIMULATORS WHERE, THE OPERATOR IS BROUGHT MORE DEEPLY INTO THE SIMULATION BECAUSE MORE OF THE SENSES ARE INVOLVED. FURTHER, EFFECTIVE THREE-DIMENSIONAL SOUNDS WILL HELP MASK THE UNWANTED SIMULATOR SOUNDS CAUSED FROM THE SIMULATOR MACHINERY ITSELF.

NIELSEN ENGINEERING & RESEARCH INC  
510 CLYDE AVE  
MOUNTAIN VIEW, CA 94043

CONTRACT NUMBER:

ROBERT E CHILDS

TITLE:

PREDICTION METHOD FOR ASTOVL GROUND EFFECTS FLOWS  
TOPIC# 1a OFFICE: TALRPO



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NUMERICAL PREDICTIONS OF GROUND EFFECTS FLOW SUFFER LOSS OF ACCURACY BECAUSE OF INADEQUATE TURBULENCE MODELS AND BECAUSE OF THE INABILITY TO TREAT COMPLEX AIRCRAFT GEOMETRY IN AN ECONOMICAL MANNER. ONE OBJECTIVE OF PHASE I IS TO DEMONSTRATE THAT DATA FROM NUMERICAL SIMULATIONS OF TURBULENCE CAN BE USED TO GUIDE THE DEVELOPMENT OF AN IMPROVED REYNOLDS-AVERAGED TURBULENCE MODEL FOR GROUND EFFECTS FLOWS. THE SECOND OBJECTIVE IS TO DEMONSTRATE AN ACCURATE, EFFICIENT METHOD OF MODELING AN AIRCRAFT-LIKE CONFIGURATION WITHIN A GRID-BASED NAVIER-STOKES CALCULATION.

NKH INC  
2325 CAMINO VIDA ROBLE - STE D  
CARLSBAD, CA 92009  
CONTRACT NUMBER:  
MICHAEL R KOZIEWICZ  
TITLE:  
SIMULATION FOR THE INDIVIDUAL FOOT SOLDIER  
TOPIC# 31a                      OFFICE: TALPRO

SIMULATION FOR VEHICLES HAS BEEN AN EXPLOSIVE GROWTH AND IS A MAJOR FACTOR IN TRAINING PROGRAMS. SIMULATION HAS NOT, HOWEVER, PROVIDED SIGNIFICANT HELP IN TRAINING THE FOOT SOLDIER IN REALISTIC COMBAT ENVIRONMENTS. THE GOAL OF THIS PROJECT IS TO DEMONSTRATE THE FEASIBILITY OF PROVIDING A REALISTIC VISUAL SCENE IN WHICH THE FOOT SOLDIER PERCEIVES ENEMY THREATS. THESE THREATS, EMBEDDED IN TERRAIN OBJECTS THAT CAN BOTH HINDER AND ASSIST THE SOLDIER, PROVIDE EXPERIENCE IN PROPER POSITIONING FOR ENGAGEMENT OR OTHER APPROPRIATE TACTICAL ACTIONS. NKH WILL PROVIDE AND DEMONSTRATE A SMALL AREA HIGH DEFINITION VISUAL SYSTEM WHICH WILL OVERLAY AN EXISTING TERRAIN TYPE VISUAL IMAGE GENERATION SYSTEM. THE HIGH DEFINITION SYSTEM WILL DISPLAY A LIMITED TASK AS VISUALLY SEEN BY THE SOLDIER DURING HIS MOVEMENT. THE MOVEMENT WILL BE ONE IN WHICH HE RISES FROM THE PRONE TO THE UPRIGHT POSITION. A TOP LEVEL DESIGN FOR A PHASE II FULL CONCEPT DEMONSTRATION WILL ALSO BE PROVIDED. SUCCESSFUL DEMONSTRATION OF THIS CONCEPT WILL SHOW DIRECT RELEVANCY TO ALL MILITARY COMBAT SCENARIOS INVOLVING PERSONNEL IN THE FIELD. APPLICATIONS TO ESCAPE AND EVASION ARE ALSO ENVISIONED.

ORTEL CORP  
2015 W CHESTNUT ST  
ALHAMBRA, CA 91803  
CONTRACT NUMBER:  
DR ISRAEL URY  
TITLE:  
ELECTRO-OPTIC TECHNIQUES FOR VERY LARGE SCALE INTEGRAT  
INTERCONNECTS  
TOPIC# 11a                      OFFICE: TALPRO

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WE PROPOSE TO DEVELOP A NEW CLASS OF OPTICAL EMITTING DEVICE FOR USE IN COMPUTER OPTICAL INTERCONNECT SYSTEM. THE NEW DEVICE IS AN ELECTROABSORPTION MODULATOR-SUPER-LUMINESCENT DIODE (EAM-SLK). THIS DEVICE DOES NOT SUFFER FROM THE SHORT COMINGS OF SEMICONDUCTOR LASERS SUCH AS, VARIABLE THRESHOLD, DIFFICULTY OF INTEGRATION AND SUCCEPTABILITY TO MODEL NOISE. THESE THREE SHORTCOMINGS ARE ELIMINATED IN THE EAM-SLD.

PHYSICAL OPTICS CORP  
2545 W 237TH ST - STE A  
TORRANCE, CA 90505  
CONTRACT NUMBER:  
DR THOMASZ JANNSON  
TITLE:  
VLSI OPTICAL INTERCONNECTS BASED ON MULTIPLEX BRAGG PL  
HOLOGRAPHY  
TOPIC# 11a                      OFFICE: TALRPO

IN THIS PROPOSED RESEARCH, POC WILL DEMONSTRATE A PLANAR HOLOGRAM TECHNOLOGY THAT CAN SERVE AS OPTICALLY INTERCONNECTS FOR VLSI DEVICES IN INTER-CHIP AND INTER-PROCESSOR APPLICATIONS. IT IS ANTICIPATED THAT THE SUCCESS OF THIS RESEARCH WILL BRING FORTH A TECHNOLOGY FOR OPTICALLY INTERCONNECTING A VERY LARGE NUMBER OF INFORMATION CHANNELS IN A MONOLITHIC INTEGRATED OPTICS PACKAGE THAT IS COMPATIBLE IN FORM FACTOR WITH THE OPTOELECTRONIC MODULES AND VLSI ELECTRONIC PARALLEL PROCESSORS FOUND IN MANY CURRENT AND FUTURE GENERATIONS OF DEFENSE COMPUTERS. IN ADDITION, THE MICRO-PLANAR HOLOGRAM TECHNOLOGY ALSO CAN PROVIDE A HIGH STORAGE CAPACITY DEVICE IN AN INTEGRATED OPTICS FORMAT FOR MANY OPTICAL AND OPTOELECTRONICS PROCESSING APPLICATIONS.

PHYSICAL SCIENCES INC  
603 KING ST  
ALEXANDRIA, VA 22314  
CONTRACT NUMBER:  
DR J T SCHRIEMPF  
TITLE:  
A NOVEL RAM CONCEPT FOR SIMULTANEOUS CONTROL OF IR SIG  
TOPIC# 2a                      OFFICE: TALPRO

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A NOVEL CONCEPT IS PROPOSED TO DEVELOP COATINGS WITH DUAL RADAR AND THERMAL SUPPRESSION CHARACTERISTICS. THE CONCEPT EMPLOYS WELL KNOWN TECHNIQUES USED FOR RADAR ABSORBING COATINGS AND COMBINES THEM WITH TECHNIQUES FOR PRODUCING LOW EMISSIVITY SURFACES IN THE INFRARED WAVELENGTHS IN A WAY IN WHICH TOTAL COMPATIBILITY IS ASSURED. VARIOUS COMBINATIONS OF MATERIALS DEMONSTRATING THE APPROPRIATE PROPERTIES AND THE REQUIRED COMPATIBILITY ARE AVAILABLE. MATERIAL TYPE AS WELL AS GEOMETRY AND CONFIGURATION CAN BE USED AS VARIABLES FOR PERFORMANCE OPTIMIZATION. IN ADDITION TO THE REQUIRED RADAR ABSORBING PROPERTIES AND LOW EMISSION OPTICAL PROPERTIES, IT APPEARS THAT AN APPROPRIATE MATERIAL SELECTION MAY ALSO PROVIDE COATINGS CAPABLE OF BEING APPLIED IN ENVIRONMENTS OF MODERATE AND ELEVATED TEMPERATURES. DURING PHASE I, AN EXAMINATION WILL BE MADE OF THE MATERIAL PARAMETERS AND THE GEOMETRIC PARAMETERS TO DETERMINE WHAT COMBINATION OF PROPERTY TYPES AND GEOMETRIES SHOULD BE EMPLOYED TO PRODUCE COATINGS POSSESSING OPTIMIZED DUAL RADAR AND THERMAL SUPPRESSION CHARACTERISTICS AS WELL AS LOW EMISSIVITIES IN THE VISIBLE SPECTRUM. MODERATE TO ELEVATED TEMPERATURE PERFORMANCE WILL ALSO BE ONE OF THE OBJECTIVES.

PRECISION ANALYTICS INC

N 110 BRIDGE ST

PALOUSE, WA 99161

CONTRACT NUMBER:

V VELPART

TITLE:

HIGH STRENGTH BASALT FIBER REINFORCED CEMENT COMPOSITE

TOPIC# 13a                      OFFICE: TALRPO

THIS RESEARCH PROPOSES TO INVESTIGATE THE REINFORCEMENT OF ORDINARY PORTLAND CEMENT BY BASALT FIBERS. APART FROM POSSESSING HIGH STRENGTH ( $500 \times 10^3$  PSI.) AND MODULUS ( $13 \times 10^6$  PSI.) BASALT FIBERS ARE DURABLE IN AN ALKALINE MEDIUM, AN ESSENTIAL REQUIREMENT FOR A FIBER IN CEMENT PASTE. BY REINFORCING WITH BASALT FIBERS HIGH STRENGTH CEMENT COMPOSITES MAY BE ACHIEVED. IT IS ENVISAGED HERE TO IMPROVE THE DURABILITY OF BASALT-CEMENT COMPOSITES BY IMPROVING FURTHER THE ALKALINE RESISTANCE OF BASALT FIBERS. THIS WILL BE ACHIEVED BY MODIFYING THE COMPOSITION OF THE BASALT FIBER BY ADDING  $Mn_2O_3$  AND OXIDE DURABLE IN ITS OWN RIGHT IN AN ALKALINE MEDIUM. CEMENT

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COMPOSITES THUS PREPARED WILL ALSO BE SUBJECTED TO ACCELERATED TESTS TO PREDICT STRENGTHS OVER EXTENDED PERIODS OF TIME.

PROGRAMMED COMPOSITES INC

380 CLIFFWOOD PK

BREA, CA 92621

CONTRACT NUMBER:

L BRIAN KELLER

TITLE:

REAL TIME IN-SITU DIELECTRIC MONITORING OF ADVANCED CO  
CURING PROCESSES

TOPIC# 10a OFFICE: TALPRO

A NOVEL TECHNIQUE FOR MONITORING PHYSICAL AND CHEMICAL CHANGES OCCURRING DURING THE CURE PROCESS IN ADVANCED COMPOSITE, ORGANIC MATRIX, LAY-UPS IS UNDER DEVELOPMENT AT PCI. CHANGES IN DIELECTRIC PROPERTIES THROUGH THE THICKNESS OF THE LAMINATE ARE DIRECTLY MEASURED, DISPLAYED, AND RECORDED IN REAL TIME. THESE CHANGES ARE CORRELATED WITH CRITICAL STEPS IN THE PROCESS WHICH MUST BE PROPERLY CONTROLLED TO PRODUCE CONSISTENT, HIGH QUALITY COMPOSITES. THIS DIELECTRIC MONITORING TECHNIQUE, CALLED RES-CAP (TM), HAS PROVED PARTICULARLY PRACTICAL AND USEFUL IN PROCESS CONTROL FOR POLYIMIDE COMPOSITES AND WORKS WITH ALL TYPES OF REINFORCEMENTS. IN THIS PROGRAM, RES-CAP TECHNIQUE WILL BE EXTENDED TO DETECTING CRITICAL EVENTS IN PROCESSING (1) CARBON-CARBON PRECURSOR STRUCTURES, AND (2) HIGH TEMPERATURE RESISTANT THERMOPLASTIC AND THERMOSETTING COMPOSITES. IMPROVEMENTS IN DETECTOR SENSITIVITY, OPERATION AT HIGHER FREQUENCIES AND MODIFICATIONS OF ELECTRODES TO WITHSTAND TEMPERATURES OF 800 DEG F MAY BE REQUIRED. DIELECTRIC RESPONSE VS TIME WILL BE CORRELATED WITH THE EVOLUTION OF INTRINSIC FEATURES RELATED TO QUALITY, UNIFORMITY AND REPRODUCIBILITY.

Q-DOT INC

1069 ELKTON DR

COLORADO SPRINGS, CO 80907

CONTRACT NUMBER:

MARGARET S MORTZ

TITLE:

APPLICATION OF ADAPTIVE NEURAL NETWORKS

TOPIC# 12a OFFICE: TALPRO

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THE PURPOSE OF THIS PHASE I PROGRAM IS TO IDENTIFY SPECIFIC TACTICAL AVIONICS APPLICATIONS WHICH COULD BENEFIT FROM THE SPECIAL INFORMATION-PROCESSING CAPABILITIES OF ADAPTIVE NEURAL NETWORKS. FOR SPECIFIC TACTICAL APPLICATIONS, A TRADE-OFF ANALYSIS OF SPECIFIC NEURAL NETWORK ARCHITECTURES WILL BE CONDUCTED WITH THE OBJECTIVE OF SELECTING THE MOST PROMISING ARCHITECTURES. A PHASE II PLAN WILL BE PROVIDED TO DEVELOP NEURAL NETWORK COMPUTATION SYSTEMS FOR INCORPORATION INTO TACTICAL AVIONICS SYSTEMS.

RD INSTRUMENTS  
9855 BUSINESSPARK AVE  
SAN DIEGO, CA 92131  
CONTRACT NUMBER:  
FRANCIS ROWE  
TITLE:  
HIGH RESOLUTION COHERENT ACOUSTIC DOPPLER CURRENT PROF  
TOPIC# 26a                      OFFICE: TALPO

THIS RESEARCH AND DEVELOPMENT PROJECT WILL STUDY THE FEASIBILITY OF DEVELOPING A HIGH RESOLUTION COHERENT ACOUSTIC DOPPLER CURRENT PROFILER (HRCADCP) SUITABLE FOR MEASURING PROFILES OF 3-AXES VELOCITY OVER SHORT RANGES WITH HIGH ACCURACY, SPATIAL RESOLUTION AND SAMPLING RATE. CAPABILITY FOR MEASURING CURRENT PROFILES FROM THE OCEAN'S SURFACE TO A 1-METER DEPTH WITH VELOCITY ACCURACY OF ORDER A FEW MM/S, SPATIAL RESOLUTION OF A FEW MM AND SAMPLING RATES OF ABOUT 10 Hz WILL BE SOUGHT. THE PROPOSED APPROACH USES A BISTATIC PULSE-COHERENT ACOUSTIC DOPPLER SYSTEM WHICH UTILIZES AN ARRAY OF FOUR RECEIVER ASSEMBLIES TO MEASURE DOPPLER FREQUENCIES FROM ECHOES SCATTERED FROM THE WATERMASS VOLUME ENSONIFIED BY A SINGLE TRANSMIT TRANSDUCER AT THE CENTER OF THE ARRAY. THE PRIMARY OBJECTIVES OF PHASE I ARE TO ANALYTICALLY DEFINE AND QUANTIFY THE SOURCES OF ERROR IN THE MEASUREMENT PROCESS, TO EXPLORE THE RELATIVE MERITS AND PERFORMANCE OF ALTERNATIVE SYSTEM GEOMETRIES AND SIGNAL PROCESSING SCHEMES, AND TO CONDUCT AN EXPERIMENT TO EVALUATE THE PRACTICAL FEASIBILITY AND PERFORMANCE OF SYSTEM.

SCIENCE RESEARCH LAB INC  
15 WARD ST  
SOMERVILLE, MA 02143  
CONTRACT NUMBER:  
DANIEL BIRX  
TITLE:  
COMPACT ACCELERATOR DESIGN BASED ON A CYCLIC INDUCTION  
WITH BRANCHED MAGNETICS  
TOPIC# 9a                      OFFICE: TALRPO

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CURRENT DESIGNS FOR HIGH CURRENT (10-100KA) ACCELERATORS ARE BASED ON LINEAR OPERATING GRADIENTS OF AT BEST 1-2 MeV/METER. IN FERRI-(FERRO) MAGNETIC INDUCTION ACCELERATORS, THESE LOW GRADIENTS ARE IMPOSED BY THE PROPERTIES OF THE MATERIAL WHICH COMPRISES THE CORE. WITH AIR CORE RADIAL LINE INDUCTION LINACS, THE CONSTRAINTS IS DERIVED FROM THE GEOMETRY OF THE RADIAL LINES AND THE DIELECTRIC BREAKDOWN STRENGTH. SIGNIFICANT REDUCTIONS IN THE SIZE AND WEIGHT OF INDUCTION LINACS WILL HAVE A CONSIDERABLE IMPACT ON THE COST EFFECTIVENESS AND MILITARY UTILITY OF INDUCTION ACCELERATORS FOR CHARGED PARTICLE BEAM WEAPON (CPBW) APPLICATIONS. THE USE OF BRANCH MAGNETIC TECHNOLOGY MAY MAKE POSSIBLE THE DESIGN OF HIGH CURRENT RECIRCULATING INDUCTION LINACS WITH SIZE REDUCTIONS OF A FEW ORDERS OF MAGNITUDE. OUR GOAL WOULD BE TO DESIGN A PROOF-OF-PRINCIPLE EXPERIMENT OUTLINING DESIGNS FOR THE BRANCHED MAGNETIC PULSE POWER DEVICE. THIS INVESTIGATION WILL LEAD TO A TECHNICAL BASIS FOR THE ACCELERATOR GAP AND ELECTRON TRANSPORT SYSTEM DESIGN FOR A SPIRAL LINE RECIRCULATING LINAC.

SECURITY TAG SYSTEMS INC  
1615 - 118TH AVE N  
ST PETERSBURG, FL 33702  
CONTRACT NUMBER:  
DR W R MENYHERT

TITLE:

MAGNETIC IMAGE SEEKER UTILIZING NEW MAGNETIC MATERIALS  
TOPIC# 22a                      OFFICE: TALRPO

IT IS PROPOSED THAT A NEW TYPE OF SOFT MAGNETIC MATERIAL CAN BE USED FOR A VERY SENSITIVE AND LOW MAGNETIC FIELD DETECTION DEVICE. TO DETECT THE MILITARY TARGETS, ONE NEEDS A HIGHLY SENSITIVE DEVICE BUT THE EXISTING FLUX-GATE MAGNETOMETERS ARE LIMITED BY THEIR SIGNAL-TO-NOISE RATIO. WITH THE DEVELOPMENT OF SUPERIOR MAGNETIC MATERIALS AND IMPROVED ELECTRONICS, SOME OF THE NOISE PROBLEMS IN FLUX-GATE MAGNETOMETERS HAS BEEN REDUCED. BUT THE PROBLEM OF LINEARITY AND SENSITIVITY STILL REMAINS TO BE SOLVED. A HIGHLY SENSITIVE, LOW NOISE MAGNETIC SENSOR IS, THEREFORE, NEEDED. THE SECURITY TAG SYSTEMS, (STS) CONCEPT OF THE MAGNETIC SENSOR IS BASED ON THE UNIQUE "PARAMETRIC AMPLIFICATION" PRINCIPLE. THE SENSITIVITY AND PERFORMANCE OF THIS DEVICE IS MUCH HIGHER COMPARED TO THE STANDARD EXISTING FLUX-GATE TYPE. THE HIGHER SIGNAL-TO-NOISE RATIO OF THE STS MAGNETIC DETECTION

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DEVICE IS THE RESULT OF A UNIQUE CHOICE OF MAGNETIC MATERIAL AND THE PHYSICAL PRINCIPLE BEHIND IT.

SEKAR ENTERPRISES  
23147 CANZONET ST  
WOODLAND HILLS, CA 91367  
CONTRACT NUMBER:  
M GUNASEKARAN  
TITLE:  
SUPER STRENGTH CEMENT PASTE MATRIX COMPOSITE MATERIALS  
MICROSTRUCTURAL CONDITIONING  
TOPIC# 13a                      OFFICE: TALPRO

THE LIMITATIONS TO THE MECHANICAL, ELECTRICAL AND DURABILITY PROPERTIES OF HYDRAULIC CEMENT-BASED CONCRETES ARISE FROM THE CAPILLARY AND GEL POROSITY OF THE CEMENT PASTE AND THE NATURE OF THEIR DISTRIBUTION. WITH THE ADVENT OF POLYMER IMPREGNATION TECHNIQUES, FIBER REINFORCING METHODOLOGIES, HIGH-TECHNOLOGY FIBERS SUCH AS CARBON AND ARAMID FIBERS, IT NOW BECOMES POSSIBLE TO DEVELOP A SUPER STRENGTH MATERIAL UTILIZING THESE MATERIALS AND METHODS SYNERGISTICALLY. RECENT DEVELOPMENTS ABROAD AND THE WORK ALREADY DONE IN THE U.S.A. ALONG THESE PATHS INDICATE THE HIGH FEASIBILITY OF DEVELOPING A SUPER STRENGTH MATERIAL IF THE HYDRAULIC CEMENT PASTE MATRIX CAN BE OPTIMIZED. THIS PROPOSAL PUTS FORTH SOME IDEAS WHICH ARE UNIQUE IN SEEKING SUCH A HIGH DEGREE OF OPTIMIZATION OF THE MATRIX THAN HAS SO FAR BEEN ATTAINED.

SMART SYSTEMS TECHNOLOGY  
7700 LEESBURG PIKE  
FALLS CHURCH, VA 22043  
CONTRACT NUMBER:  
KENNETH C HAYES JR  
TITLE:  
INTELLIGENT DATABASE ACCESS THROUGH A CONCEPT ORIENTED  
TOPIC# 18a                      OFFICE: TALPRO

INFORMATION IS A VALUABLE RESOURCE OF ORGANIZATIONS. AN ADEQUATE AMOUNT OF ACCURATE AND TIMELY INFORMATION IS VITAL TO ANALYSIS,

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PLANNING, AND DECISION-MAKING. CURRENTLY INFORMATION IS NOT BEING ADEQUATELY MANAGED AS A RESOURCE. SPECIALIZED SKILLS ARE OFTEN NEEDED TO PROPERLY ACCESS INFORMATION IN DATA BASES. THE USER INTERFACES OF CURRENT DATA MANAGEMENT SYSTEMS REQUIRE THEIR USERS TO KNOW TOO MANY DETAILS OF HOW AND WHERE INFORMATION IS STORED. SST HAS DEVELOPED A FRONT-END TO A DATA BASE THAT ALLOWS USERS TO CREATE AND MANIPULATE EXPRESSIONS INVOLVING CONCEPTS. THE SYSTEM HELPS USERS INCREMENTALLY DEVELOP AND REFINE THE CONCEPT EXPRESSION THAT CORRESPONDS TO THEIR ORIGINAL, ILL SPECIFIED QUESTION. IT THEN CAN AUTOMATICALLY TRANSLATE THE CONCEPT EXPRESSION SO THAT THE CORRESPONDING INFORMATION IN THE DATA BASE CAN BE RETRIEVED. EXTENDING THE CONCEPT EXPRESSION LANGUAGE AND USER INTERFACE MECHANISMS OF THE FRONT-END WOULD ALLOW MANY MORE INFORMATION USERS TO EFFICIENTLY AND EFFECTIVELY ACCESS DATA. THIS WOULD INCREASE THEIR PRODUCTIVITY AND THE QUALITY OF THE ANALYSES, PLANS, AND DECISIONS THEY MAKE.

SMART SYSTEMS TECHNOLOGY

7700 LEESBURG PIKE  
FALLS CHURCH, VA 22043

CONTRACT NUMBER:

CRAIG WILL

TITLE:

AUDITORY MODELING FOR SPEECH RECOGNITION

TOPIC# 19a                      OFFICE: TALRPO

THE GOAL OF THIS PROJECT IS TO DEVELOP TECHNIQUES FOR COMPUTER SPEECH RECOGNITION USING PARALLEL DISTRIBUTED PROCESSING MODELS. THESE MODELS ARE BASED UPON THEORIES OF HUMAN COGNITIVE PROCESSING AND HAVE SEVERAL USEFUL PROPERTIES. THEY ARE VERY EFFECTIVE AND EFFICIENT AT INTEGRATING TOGETHER IMPRECISE INFORMATION, AND THUS FOR INTEGRATING MULTIPLE SOURCES OF KNOWLEDGE FOR SPEECH RECOGNITION. THEY CAN ORGANIZE THEMSELVES AS THE RESULT OF EXPERIENCE, AND THUS LEARN TO USE SPEECH MECHANISMS FOR RECOGNITION THAT ARE ONLY POORLY UNDERSTOOD. THEY ARE NATURALLY PARALLEL AND ESPECIALLY SUITED FOR MASSIVELY PARALLEL MACHINE ARCHITECTURES, AND ARE ALSO RELATIVELY INSENSITIVE TO DAMAGE TO MACHINE HARDWARE. THESE PROPERTIES ALLOW SPEECH RECOGNITION SYSTEMS TO BE BUILT THAT CAN MAKE USE OF SPEECH INFORMATION THAT IS DIFFICULT TO DO WITH CONVENTIONAL SYMBOLIC COMPUTATION. THEY ALSO ALLOW SYSTEMS THAT CAN OPERATE IN HARSH ENVIRONMENTS SUCH AS THAT OF



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A MILITARY AIRCRAFT. THIS PROJECT INVESTIGATES ARTIFICIAL INTELLIGENCE ARCHITECTURES FOR COMPUTER SPEECH RECOGNITION BASED UPON THESE MODELS, BY TRAINING A MODEL RECOGNITION SYSTEM, EVALUATING ITS PERFORMANCE, AND ANALYZING THE ORGANIZATIONAL STRUCTURE IT DEVELOPS.

SPARTA INC  
PO BOX 1354 - 1055 WALL ST/STE 200  
LA JOLLA, CA 92038  
CONTRACT NUMBER:  
ROBERT M WASHBURN  
TITLE:  
LONG-TERM OXIDATION PROTECTION OF CARBON-CARBON FLIGHT  
TOPIC# 5a                      OFFICE: TALPRO

HIGH-STRENGTH CARBON-CARBON COMPOSITES ARE CANDIDATE STRUCTURAL MATERIALS FOR THE NATIONAL AERO-SPACE PLAN (NASP) IF LONG-TERM OXIDATION PROTECTION CAN BE DEVELOPED. THE SPARTA CONCEPT FOR OXIDATION PROTECTION COATINGS FOR LONG-TERM USE IN AN ULTRAHIGH TEMPERATURE FLIGHT ENVIRONMENT INVOLVES A GRADED PROPERTY, MULTILAYER COATING (GPMC). THE GPMC PERFORMS SEVERAL FUNCTIONS AND OVERCOMES THE VARIOUS FAILURE MECHANISMS WHICH HAVE BEEN OBSERVED PREVIOUSLY: (1) CARBON DIFFUSION IS CONTROLLED RESULTING IN THE STABILIZATION OF THE INTERFACE BETWEEN THE COATING AND THE CARBON-CARBON COMPOSITE, (2) OXYGEN DIFFUSION IS CONTROLLED BY THE USE OF A NEW BARRIER CONCEPT WITHIN THE MULTILAYER COATING, AND (3) COEFFICIENT OF EXPANSION MISMATCH PROBLEMS ARE OVERCOME BY GRADING THE COMPOSITION (AND THEREFORE, THE PROPERTIES) WITHIN THE VARIOUS LAYERS OF THE COATING. NEW SOL-GEL PROCESSING TECHNOLOGY BEING DEVELOPED AT SPARTA WILL BE USED TO FABRICATE COATED CARBON-CARBON COMPOSITE SPECIMENS. THIS PROGRAM IS DESIGNED TO ANALYTICALLY AND EXPERIMENTALLY DETERMINE THE FEASIBILITY OF DEVELOPING OXIDATION PROTECTION COATINGS FOR LONG-TERM USE IN ULTRAHIGH TEMPERATURE FLIGHT ENVIRONMENTS.

SPEECH SYSTEMS INC  
18356 OXNARD ST  
TARZANA, CA 91356  
CONTRACT NUMBER:  
DR BENJI WALD  
TITLE:  
SPEECH REPRESENTATION AND SPEECH UNDERSTANDING  
TOPIC# 17a                      OFFICE: TALPRO

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SPEECH UNDERSTANDING UTILIZES SOURCES OF KNOWLEDGE OUTSIDE OF THE SPEECH SIGNAL TO RESOLVE THE AMBIGUITY INHERENT IN SPEECH. THE EFFICIENCY AND ACCURACY OF THIS PROCESS IS CLOSELY RELATED TO THE REPRESENTATION OF THE INFORMATION IN THE SPEECH SIGNAL. IF THE SPEECH REPRESENTATION CONDENSES THE RELEVANT INFORMATION IN THE SPEECH SIGNAL WELL, OTHER SOURCES OF KNOWLEDGE CAN BE APPLIED SUCCESSIVELY WITHOUT DESTROYING THE ORIGINAL INFORMATION IN THE SPEECH SIGNAL--AND PERHAPS COMPOUNDING ERRORS. THE PROPOSED STUDY WILL ANALYZE ALTERNATIVE REPRESENTATION OF THE INFORMATION IN THE SPEECH SIGNAL, INCLUDING THE INTRINSIC AMBIGUITY. WE WILL MODEL KNOWLEDGE SOURCES SUCH AS VOCABULARY, SYNTAX, AND APPLICATION--SPECIFIC KNOWLEDGE MODELS AT A GLOBAL LEVEL, AND, BY EXAMPLE, EXAMINE TRADEOFFS IN ACCURACY AND COMPUTATIONAL COMPLEXITY FOR GIVEN SPEECH REPRESENTATIONS. THE RESULTING REPORT WILL CLARIFY ALTERNATIVES AND THEIR RELATIVE BENEFITS.

STRUCTURAL ANALYSIS TECHNOLOGIES INC  
10440 S De ANZA BLVD - D7  
CUPERTINO, CA 95014  
CONTRACT NUMBER:  
DR HASAN KAMIL  
TITLE:  
INTEGRATED SYSTEM COMBINING KNOWLEDGE-BASED SYSTEMS WITH  
SYSTEMS  
TOPIC# 18a                      OFFICE: TALRPO

KNOWLEDGE-BASED SYSTEMS IN GENERAL AND EXPERT SYSTEMS IN PARTICULAR HAVE BEEN SUCCESSFULLY UTILIZED IN THE RAPID PROTOTYPE DEVELOPMENT OF COMPLEX MILITARY SYSTEMS. IN MANY CASES, THESE PROTOTYPE SYSTEMS HAVE EMPHASIZED THE NEED FOR TECHNIQUES TO INTEGRATE KNOWLEDGE-BASED PROCESSING WITH METHODS FOR MANAGING LARGE AMOUNTS OF DATA AND KNOWLEDGE. THE PROPOSED EFFORTS WILL BE CONCENTRATED ON PRELIMINARY DEVELOPMENT AND FEASIBILITY STUDIES OF METHODS AND SOFTWARE FOR INTEGRATION OF THESE TECHNIQUES.

SYNEURONIX  
12937 KENTBURY DR  
CLARKSVILLE, MD 21029  
CONTRACT NUMBER:  
ALFRED J COTE JR  
TITLE:  
PHONEME RECOGNITION AND DISPLAY  
TOPIC# 19a                      OFFICE: TALRPO

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CONSIDERATION OF NEURAL- AND COCHLEA-BASED MODELS OF AUDITORY PROCESSING SUGGEST ANALOG PROCESSES THAT WILL BE IMPLEMENTED TO DEMONSTRATE: (1) A SPECTRAL SHAPE BASIS FOR PHONEME RECOGNITION; (2) ROBUST RECOGNITION OF PHONEME CLASSES; (3) SPEAKER INDEPENDENCE; AND (4) VOICE-SYNCHRONOUS PROCESSING. DEMONSTRATIONS WILL BE IMPLEMENTED ON AN IBM-COMPATIBLE PC USING NOVEL DISPLAY MECHANISMS THAT DIRECTLY PORTRAY THE PHONEME CONTENT OF SPEECH AS A FUNCTION OF TIME. THE EFFORT INVOLVES DESIGN AND IMPLEMENTATION OF A SPECTRAL PROCESSING CARD THAT INSTALLS IN A COMPUTER ACCESSORY SLOT AND FOUR SOFTWARE FUNCTIONS IMPLEMENTED USING THE APL LANGUAGE.

TECHNOLOGY INTERNATIONAL INC  
429 W AIRLINE HWY - STE S  
LaPLACE, LA 70068  
CONTRACT NUMBER:  
DR N (BILL) MORCOS

TITLE:  
REDUNDANT STANDOFF DETECTION CAPABILITY FOR EXPLOSIVE  
ORDNANCE BASED ON OPTIMAL SELECTION OF ADVANCED TECHNO  
TOPIC# 25a OFFICE: TALRPO

A CRITICAL TECHNOLOGY ASSESSMENT EFFORT IS PLANNED TO EXPLORE THE VIABILITY OF APPLYING ADVANCED NON-DESTRUCTIVE TESTING METHODS IN DETECTION OF EXPLOSIVES. THE ASSESSMENT WILL BE FOLLOWED BY SCREENING TECHNOLOGIES WHICH ARE IMPRACTICAL; DOES NOT MEET THE REQUIREMENTS. OUT OF THE SCREENED TECHNOLOGIES OPTIMAL ALTERNATIVE STRATEGIES WILL BE DEFINED TO DEVELOP A CONCEPT FOR THE RSDC. THE FORMULATED CONCEPT WILL BE ANALYZED AND EVALUATED. PLANS FOR DEMONSTRATION WILL ALSO BE MADE.

TECHNOLOGY SYSTEMS INC  
PO BOX 85  
NORTH EDGEComb, ME 04556  
CONTRACT NUMBER:  
CHARLES J BENTON

TITLE:  
SPECIFICATION AND PERFORMANCE EVALUATION OF A LOW COST  
SIMULATION SYSTEM  
TOPIC# 30a OFFICE: TALRPO

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DEVELOPMENT OF A SIMULATION NETWORK USING ARCADE LEVEL TECHNOLOGY WILL PROVIDE A LOW COST, INTERACTIVE MULTI-USER TRAINING ENVIRONMENT FOR USE IN THE DEVELOPMENT OF TEAMWORK SKILLS OF PERSONNEL. THE SYSTEM WILL BE SUITABLE FOR USE IN A BROAD SPECTRUM OF ROLES, AND WILL PROVIDE A FOUNDATION FOR THE ADVANCEMENT OF MODERN TRAINING METHODS. IT WILL ALLOW INNOVATIONS ADDRESSING THIS AND OTHER TECHNOLOGIES TO BE STUDIED IN A CONTROLLED ENVIRONMENT. SEPEARATE ARCADE LEVEL "SIMULATION ISLANDS" WILL BE DEVELOPED AND LINKED TOGETHER TO FORM THE NETWORK. SIMULATION ISLANDS ARE ARCADE STYLE DEVICES DESIGNED TO SIMULATE COMBAT ROLES AND TO BROADCAST AND RECEIVE NETWORK DATA. SIMULATION ISLAND WILL BE DEVELOPED FOR A VARIETY OF ROLES, SO THAT TEAM MEMBERS FROM VARIOUS DISCIPLINES MAY BE TRAINED USING A COMMON NETWORK. THE PRIMARY PHASE I OBJECTIVE IS THE DEVELOPMENT OF SPECIFICATIONS AND PERFORMANCE ESTIMATES. PHASE II WILL PRODUCE COMPLETED SYSTEMS.

TROGLODYTE SOCIETY INC  
1400 POST LN  
BOWIE, MD 20716  
CONTRACT NUMBER:  
DR FRANCIS E COUNCIL  
TITLE:

QUADRUPOLE ELECTROMAGNETIC RADIATION AS APPLIED TO STA  
DETECTION OF MINES AND EXPLOSIVES DEVICES  
TOPIC# 25a                      OFFICE: TALRPO

THE FAILURE OF FAR FIELD ELECTROMAGNETIC THEORY TO BE COMPLETELY USEFUL AS A TECHNIQUE FOR DETECTION THEORY AS APPLIED TO THE DETECTION OF MINES AND NON-METALLIC OBJECTS IN SOIL LEADS TO THE IDEA THAT PERHAPS DETECTION IS A NEAR FIELD PROBLEM. BY SYNTHESIZING A NEAR FIELD BY DRIVING APPROPRIATE ANTENNAS AND USING THIS SYNTHESIZED NEAR FIELD IN A DETECTION SYSTEM, THEN INCREASED RANGE AND SIGNAL PROCESSING CAPABILITY MIGHT BE EXPECTED. THE LIKELY COMPONENTS OF THE NEAR FIELD THAT WOULD BE USEFUL ARE QUADRUPOLE AND OCTOPOLE RADIATION. FEASIBILITY STUDIES OF THE CONCEPT WOULD INCLUDE CALCULATION AND COMPARING SCATTERING CROSS SECTIONS OF TYPICAL TARGETS BY DIPOLE, QUADRUPOLE, AND OCTOPOLE RADIATION, DETERMINATION OF THE ARRANGEMENT OF ELEMENTS OF ANTENNAS DESIGNED FOR QUADRUPOLE AND OCTOPOLE RADIATION FOR MAXIMUM DIRECTIVITY AND ALSO DETERMINATION OF INPUT IMPE-

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DANCES FOR THE VARIOUS ANTENNAS.

VERITAY TECHNOLOGY INC  
PO BOX 305 - 4845 MILLERSPORT HWY  
EAST AMHERST, NY 14051  
CONTRACT NUMBER:  
G A STERBUTZEL  
TITLE:  
NATIONAL AERO-SPACE PLANE TECHNOLOGY INNOVATIONS INDEP  
AIR-SPEED SENSOR  
TOPIC# 5a                      OFFICE: TALRPO

THE PROPOSAL PROVIDES FOR: 1. DEFINITION OF THE NATIONAL AEROSPACE PLANE (NAP) FLIGHT ENVELOPE. 2. DESIGN OF THE NEW VERITAY HIGH-SPEED SENSOR. 3. CONDUCT OF A DESIGN EVOLUTION. 4. SIMULTANEOUS TESTING FOR RESPONSE TIME, ACCURACY, ETC. 5. SUBMISSION OF A REPORT. AN EQUIVALENT AMOUNT OF WORK WOULD THEN BE DONE ON NEW YORK STATE MATCHING FUNDS TO DEVELOP A PROTOTYPE CAPABLE OF BEING FLIGHT TESTED.

WOODSIDE DESIGN ASSOCS INC  
654 BAIR ISLAND RD - STE 206  
REDWOOD CITY, CA 94063  
CONTRACT NUMBER:  
STEVEN G KITCHEN  
TITLE:  
VIDEO ARCADE LEVEL TRAINING DEVICES  
TOPIC# 30a                      OFFICE: TALRPO

AS THE DEVELOPER OF THE FIRST SPACE FLIGHT SIMULATION GAME, "SPACE SHUTTLE - A JOURNEY INTO SPACE" WHICH WAS DESIGNED WITH THE SUPPORT AND ENCOURAGEMENT OF NASA, AND AS AN ONGOING CONTRACTOR TO DOD PRIME CONTRACTORS FOR DESIGN AND DEVELOPMENT OF ADVANCED ELECTRONIC SYSTEMS, WOODSIDE DESIGN ASSOCIATES, INC. (WDA) IS IN A UNIQUE POSITION TO PROVIDE A COMPLEX COMBINATION OF ELECTRONIC, TACTICAL AND GAMING EXPERTISE. PHASE I OF THIS SBIR WILL PROVIDE FOR THE FLOW CHARTING AND DETAILED, PLOTTING OF THE TRAINING DEVICE. THE TECHNOLOGIES CAPABLE OF INCORPORATION INTO THE DEVICE ARE VOICE, MOUSE, JOYSTICK AND TOUCH PANEL INPUT, REALISTICALLY BASED COMPUTER GENERATED GRAPHICS

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AND A NETWORKING STRUCTURE WHICH WILL ALLOW NOT ONLY MULTIPLE PARTICIPANTS (UP TO 512 TERMINALS WHILE MAINTAINING REAL-TIME INTEGRITY) BUT PARTICIPANTS WORKING IN A VARIETY OF LOCATIONS. PHASE II WILL PROVIDE FOR THE ACTUAL PROTOTYPING OF THE ASSEMBLED DEVICE AND, AS THESE TECHNOLOGIES ARE ALREADY IN RESIDENCE AND AVAILABLE AT WDA, PHASE I WILL INCLUDE A DEMONSTRATION OF EACH OF THE INDIVIDUAL COMPONENTS. SINCE WDA IS LONG FAMILIAR WITH THE COST CONSTRAINTS OF THE HIGH VOLUME CONSUMER MARKET, THIS DEVICE IS SEEN AS BEING WELL WITHIN THE \$10,000 STATED COST RANGE.

WOOLLAM J A CO  
2436 SHERIDAN  
LINCOLN, NE 68502  
CONTRACT NUMBER:  
JOHN A WOOLLAM  
TITLE:  
MONOLAYER RESOLUTION CHARACTERIZATION BY VARIABLE ANGLE  
SPECTROSCOPIC ELLIPSOMETRY (VASE)  
TOPIC# 14a                      OFFICE: TALRPO

ELLIPSOMETRY USES POLARIZED LIGHT REFLECTANCE TO CHARACTERIZE SURFACES, INTERFACES, AND THIN FILMS. ELLIPSOMETRY HAS TRADITIONALLY BEEN DONE USING A FEW (USUALLY ONE) DISCRETE ANGLES OF INCIDENCE OF THE LIGHT BEAM WITH A SURFACE NORMAL, AND A FEW SELECTED WAVELENGTHS (FREQUENTLY ONLY 632.8 nm FROM A HeNe LASER). RECENTLY IT WAS SHOWN (BY WOOLLAM AND COWORKERS) THAT USING VARIABLE ANGLE OF INCIDENCE SPECTROSCOPIC ELLIPSOMETRY THE SENSITIVITY CAN BE ENHANCED BY MORE THAN THREE ORDERS OF MAGNITUDE. THE USEFULNESS OF THIS TECHNIQUE FOR HETEROJUNCTION STRUCTURES WAS DEMONSTRATED. THE PURPOSE OF THIS CONTRACT IS THREEFOLD: TO DEVELOP VASE FOR MOCVD GROWN MULTILAYER SEMICONDUCTOR DIAGNOSTICS, TO ENHANCE THE DATA ACQUISITION SPEED BY A FACTOR OF TEN (THUS PERMITTING IN-SITU CAPABILITIES), AND TO DEVELOP THE CAPABILITY TO ANALYZE DATA FROM SEMICONDUCTOR SUPERLATTICES USING AN IBM AT COMPATIBLE COMPUTER.

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TOTAL NUMBER OF AWARDS: 59

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APPLIED RESEARCH CORP  
8201 CORPORATE DR - STE 920  
LANDOVER, MD 20785  
CONTRACT NUMBER:  
A K DRUKTER  
TITLE:  
RADIATION HARD X-RAY GAMMA AND NEUTRON DETECTORS  
TOPIC# 3                      OFFICE: DNA

APPLIED RESEARCH CORPORATION (ARC) PROPOSES TO DEVELOP A NEW CLASS OF SOLID-STATE PARTICLE/RADIATION DETECTORS. USING CRYOGENIC TECHNIQUES, ORDER-OF-MAGNITUDE IMPROVEMENTS IN THE MAXIMUM TOLERABLE RADIATION DOSE ARE EXPECTED; A RADIATION DOSE OF 100 MEGARAD SHOULD NOT DESTROY THE DETECTOR CAPABILITIES. THE DETECTOR PROVIDES EXCELLENT PROTECTION AGAINST ELECTROMAGNETIC AND RADIATION EFFECTS WHICH MIGHT BE ENCOUNTERED IN AN UNDERGROUND NUCLEAR TEST. THE DETECTOR CAN CONSIST OF A LARGE ARRAY (10[5]X10[5]) OF SUPERCONDUCTING SENSORS AND COULD PROVIDE SPATIAL RESOLUTION OF A FEW MICRONS WITH A REASONABLE NUMBER OF READ-OUT CHANNELS. SUBNANOSECOND TIME RESOLUTION IS POSSIBLE. IT CAN BE ENGINEERED AS DETECTORS FOR X-RAY, GAMMA AND NEUTRON RADIATION.

ATMOSPHERIC & ENVIRONMENTAL RESEARCH INC  
840 MEMORIAL DR  
CAMBRIDGE, MA 02139  
CONTRACT NUMBER:  
M K W KO/W -C WANG  
TITLE:  
ATMOSPHERIC EFFECTS OF A NUCLEAR EXCHANGE: MODIFICATION  
COMPOSITIONS OPTICAL PROPERTIES AND CLIMATE  
TOPIC# 1                      OFFICE: DNA

IN THE LAST TWO YEARS, THERE HAVE BEEN INCREASING CONCERNS ABOUT THE POTENTIALLY LARGE COOLING OF THE LAND SURFACE TEMPERATURE RESULTING FROM THE SOOT AND DUST INJECTED INTO THE ATMOSPHERE BY THE EXPLOSIONS AND SECONDARY FIRES FROM NUCLEAR EXCHANGES, THE SO-CALLED "NUCLEAR WINTER" SCENARIOS. HERE WE ARGUE THAT, IN ADDITION TO DUST AND SOOT, A LARGE NUMBER OF TRACE GASES (NO[x], H[2]O, HC, CH[4]) CAN ALSO BE ADDED TO THE ATMOSPHERE, IN AMOUNTS COMPARABLE TO A NORMAL ONE-YEAR

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INVENTORY FOR MANY OF THE ATMOSPHERE'S MOST IMPORTANT INDIVIDUAL TRACE GASES. THESE TRACE GASES ARE CHEMICALLY ACTIVE AND HAVE THE ABILITY TO ALTER THE COMPOSITIONS OF THE RADIATIVELY-ACTIVE SPECIES WHICH, TO A LARGE EXTENT, DETERMINE THE OPTICAL PROPERTIES OF THE ATMOSPHERE AND CONTROL THE EARTH'S CLIMATE. BECAUSE OF THE LONG RESIDENCE TIMES OF THESE SPECIES, THE IMPACT IN THE ATMOSPHERE MAY LAST FOR YEARS INSTEAD OF MONTHS AS IN THE CASE OF DUST AND SOOT INJECTION. WE PROPOSE TO INVESTIGATE THESE EFFECTS USING A 1-D MODEL OF THE ATMOSPHERE WITH INTERACTIVE TREATMENT OF RADIATION, CHEMISTRY, AND DYNAMICS. THIS STUDY WILL PROVIDE ESTIMATES OF THE CHANGES IN THE ATMOSPHERIC OPTICAL PROPERTIES AND COMPOSITION AND THE RELATIVE IMPORTANCE OF THE TRACE GASES' GREENHOUSE EFFECT TO THE COOLING DUE TO DUST AND SOOT.

ATSS INC  
606 E MILL ST - STE 1022  
SAN BERNARDINO, CA 92408  
CONTRACT NUMBER:  
HENRY L MOODY  
TITLE:  
FRATRICIDE EFFECTS ON ANTENNA BORESIGHT ERRORS  
TOPIC# 1 OFFICE: DNA

THE GUIDANCE AND SURVEILLANCE ACCURACIES OF ADVANCED AIR FORCE REENTRY SYSTEMS DEPEND ON ANTENNA WINDOW SHAPE CHANGE (OR ABLATION) AT THE TIME OF THE GUIDANCE UPDATE OR SURVEILLANCE FUNCTION. GUIDANCE UPDATE AND SURVEILLANCE OCCUR IN ALTITUDE REGIMES WHERE PRECURSOR DUST FIELDS CAN EXIST. DUST EROSION OF THE WINDOW WILL CAUSE BORE-SIGHT ERRORS AND SUBSEQUENT SYSTEM INACCURACIES. THE PURPOSE OF THE PROPOSED PROGRAM IS TO ESTABLISH THE MAGNITUDE OF THE BORESIGHT ERROR INDUCED BY PRECURSOR DUST FIELDS.

CARPENTER RESEARCH CORP  
27520 HAWTHORNE BLVD - STE 263  
ROLLING HILLS EST, CA 90274  
CONTRACT NUMBER:  
HERMAN J CARPENTER  
TITLE:  
SNOB/GREG CALIBRATOR DEVELOPMENT  
TOPIC# 3 OFFICE: DNA



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THE OBJECTIVES OF THIS WORK ARE TO ESTABLISH THE DESIGN REQUIREMENTS, TECHNICAL FEASIBILITY A BASIC DESIGN, AND A COST DATA BASE FOR DESIGNING AND CONSTRUCTING A LOW COST BUT ADEQUATE CAPABILITY FOR CALIBRATING PRESSURE INSTRUMENTATION USED FOR MEASURING DUSTY BLAST FLOW. IN PARTICULAR SUCH A CALIBRATION FACILITY WOULD BE CAPABLE OF CALIBRATING SINGLE AND MULTIPLE SNOB/GREG PROBES AT THE FLOW SPEEDS AND DUST DENSITIES OF INTEREST TO DUSTY FLOW EXPERIMENTS CONDUCTED IN LARGE AND SMALL HE FIELD TESTS AND IN SHOCK TUBE TESTS. THE CALIBRATOR IS SORELY NEEDED FOR ESTABLISHING THE ACCURACY OF DUST FLOW INSTRUMENTATION FOR THE MISTY PICTURE EVENT AND SIMILAR SUCH TESTS. AT THIS POINT NO POTENTIAL COMMERCIAL APPLICATIONS HAVE BEEN IDENTIFIED FOR THE CALIBRATOR.

ENGINEERING & ECONOMICS RESEARCH INC  
1801 ALEXANDER BELL DR - STE 400  
RESTON, VA 22091

CONTRACT NUMBER:

JOSEPH L MEGLEN

TITLE:

ANALYSIS OF NUCLEAR WEAPONS EFFECTS ON STRATEGIC STRUC  
TOPIC# 1                      OFFICE: DNA

SUBSTANTIAL PROGRESS HAS BEEN MADE IN RECENT YEARS TO DEVELOP AND VALIDATE MODELS WHICH CAN PREDICT THE PHYSICAL EFFECTS OF NUCLEAR WEAPONS ON STRATEGIC STRUCTURES. SIGNIFICANT UNCERTAINTIES REMAIN, HOWEVER, IN THE CONFIDENCE LEVELS ATTRIBUTABLE TO THESE PREDICTIVE CAPABILITIES. THIS APPROACH WOULD IDENTIFY AND PRIORITIZE THOSE ACTIVITIES, ALONG WITH THEIR ASSOCIATED BUDGETARY AND SCHEDULING CONSIDERATIONS, WHICH WOULD MOST EFFICIENTLY ACCOMPLISH THE TECHNICAL OBJECTIVES NECESSARY TO ADDRESS RELEVANT LETHALITY AND VULNERABILITY ISSUES. THE PROPOSED EFFORT WILL DEVELOP AND VALIDATE SUCH A METHODOLOGY FOR AN ILLUSTRATIVE ACTIVITY SUCH AS THE MISTY ECHO PROJECT USING A DELPHI APPROACH. THIS WILL BE ACCOMPLISHED BY: REVIEWING THE STATE-OF-THE-ART, EMPHASIZING IDENTIFICATION OF NECESSARY MODEL ELEMENTS; FORMULATING R&D TARGETS; DEVELOPING A NETWORK OF R&D AND SUPPORT ACTIVITIES TO MEET THE TARGETS WITH ASSOCIATED COST AND SCHEDULING CONSIDERATIONS; ESTIMATING RISK FACTORS ASSOCIATED WITH EACH ACTIVITY; AND CALCULATING BENEFIT/COST RATIOS. THE RESULTING METHODOLOGY WILL REDUCE THE UNCERTAINTIES INHERENT IN CURRENT MODELS

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AND CAN, UNDER THE PHASE II EFFORT, BE EXTENDED TO OTHER R&D PROGRAMS WITHIN DNA. THE OVERALL BENEFIT WILL BE TO ENHANCE NATIONAL SECURITY BY MORE OPTIMAL ALLOCATION OF NUCLEAR WEAPONS SYSTEMS. THE METHODOLOGY WOULD HAVE THE POTENTIAL FOR APPLICATION TO OTHER DNA PROGRAMS AND A WIDE RANGE OF OTHER R&D PROCESSES.

FLUID PHYSICS IND  
4265 MANCHESTER AVE  
ENCINITAS, CA 92024  
CONTRACT NUMBER:  
RICHARD M TRACI

TITLE:  
STOCHASTIC PARTICLE TURBULENT TWOPHASE FLOW ANALYSIS O  
SCOURING  
TOPIC# 1                      OFFICE: DNA

THE PROBLEM OF AERODYNAMIC ENTRAINMENT OF PARTICULATE FROM FRANGIBLE MATERIALS HAS CONSIDERABLE GEOPHYSICAL, TECHNOLOGICAL, AND MILITARY SIGNIFICANCE. PROBLEMS SUCH AS SOIL EROSION, TERRESTRIAL AND PLANETARY DUST STORMS, COAL MINE SAFETY, JET OR DOWNWASH IMPINGEMENT, CHEMICAL PROCESS TECHNOLOGIES AND EXPLOSION GENERATED DUSTY BOUNDARY LAYERS ARE DEPENDENT ON THE PARTICLE SCOURING MECHANISM. THE EFFECT OF TURBULENT TWOPHASE FLOW INTERACTION PROCESSES COMPLICATE THE PROBLEM AND HAVE LIMITED THE DEVELOPMENT OF A COMPREHENSIVE UNDERSTANDING. THE PRESENT PROPOSAL ADDRESSES THESE NEEDS BY APPLYING RECENT DEVELOPMENTS FROM THE CHEMICAL SCIENCES IN THE AREA OF TURBULENT PARTICLE INTERACTION MODELING TO IMPLEMENT A TOOL FOR TURBULENT TWOPHASE BOUNDARY LAYER FLOW ANALYSES. THE TOOL WILL BE UTILIZED TO EXAMINE THE PARAMETRIC DEPENDENCIES OF THE ENTRAINMENT PROCESS RELATIVE TO A RECENTLY DEVELOPED DUSTY BOUNDARY LAYER DATA BASE COLLECTED BY THE DEFENSE TECHNOLOGY SECTOR. KEY AND NOVEL FEATURES OF THE APPROACH INCLUDE A STOCHASTIC PARTICLE MODEL WITH DYNAMIC TURBULENT DIFFUSION AND GAS PHASE TURBULENCE COUPLING, AS WELL AS THE MIXING-CONTROLLED PARTICLE ENTRAINMENT SURFACE INTERACTION MODEL APPLIED TO A NEW AND HERETOFORE UNAVAILABLE DATA BASE. THE OBJECTIVE WILL BE TO RECONCILE THIS NEW DATA WITH THE HISTORICAL DATA FROM OTHER TECHNICAL FIELDS TO DEVELOP AN IMPROVED UNDERSTANDING OF AN IMPORTANT MULTIDISCIPLINARY PROBLEM.

HY-TECH RESEARCH CORP  
PO BOX 3422  
RADFORD, VA 24143  
CONTRACT NUMBER:  
EDWARD J YADLOWSKY

TITLE:  
LASER INDUCED FLUORESCENCE MEASUREMENTS OF MAGNETIC FI  
IN HIGH CURRENT DEVICES  
TOPIC# 2                      OFFICE: DNA

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THE DISTRIBUTION OF THE MAGNETIC FIELD IN A HIGH CURRENT PLASMA DEVICE PROVIDES IMPORTANT INFORMATION ABOUT THE DEVICES OPERATION. TRADITIONAL FARADAY ROTATION, ZEEMAN EMISSION SPECTROSCOPY, AND MAGNETIC PROBE TECHNIQUES SUFFER FROM POOR SPATIAL RESOLUTION BECAUSE THE MAGNETIC FIELD EFFECT IS INTEGRATED ALONG THE LINE OF SIGHT FOR THE OPTICAL TECHNIQUE AND THE PROBES PERTURB THE PLASMAS. A LASER INDUCED FLUORESCENCE (LIF) TECHNIQUE IS PROPOSED TO MEASURE THE SPATIAL AND TEMPORAL EVOLUTION OF CONSTANT MAGNETIC FIELD CONTOURS IN THESE DEVICES. THIS TECHNIQUE UTILIZES A DYE LASER TUNED TO A ZEEMAN SHIFTED ELECTRONIC TRANSITION FREQUENCY TO LOCALLY EXCITE THE TARGET ATOMS/IONS TO A HIGHER ENERGY STATE. THE INTENSITY DISTRIBUTION OF THE EMITTED RADIATION EMITTED PERPENDICULAR TO THE BEAM IS A MEASURE OF THE LOCATION OF THE MAGNETIC FIELD CONTOUR IN THE PATH OF THE LASER. A STREAK CAMERA CAN BE USED TO MEASURE THE TEMPORAL MOTION OF THE CONTOURS AND A FRAMING CAMERA CAN BE USED TO RECORD THE SPATIAL PROFILE OF THE CONTOURS. MORE THAN ONE MAGNETIC FIELD CONTOUR CAN BE SIMULTANEOUSLY RECORDED USING AN ELECTRONIC TRANSITION HAVING A COMPLEX ZEEMAN SPECTRUM. THE TECHNIQUE IS APPLICABLE TO MEASURE LARGE MAGNETIC FIELDS (10 GK - 1 MG) WHEN THE ZEEMAN SHIFT IS LARGE COMPARED TO THE ABSORPTION LINEWIDTH OF THE TRANSITION PROBED.

INNOVATIVE MECHANICS INC  
265 COE RD  
CLARDENDON HILLS, IL 60514  
CONTRACT NUMBER:  
DR ANDRES PEEKNA  
TITLE:  
DEVELOPMENT OF A SOIL STRESS GAGE FOR THE RANGE 0.05 T  
(1 1/2 TO 10 KBAR)  
TOPIC# 3                      OFFICE: DNA

IT IS PROPOSED TO DEVELOP A STRESS GAGE FOR THE RANGE 1/2 TO 10 KILOBARS, SUITABLE FOR USE IN SOIL AND WEAK ROCK, IN FREE-FIELD AND ON-STRUCTURE APPLICATIONS. IN ADDITION TO THE USUAL COMPRESSIVE STRESS SENSING CAPABILITY, THERE WOULD ALSO BE A SHEAR STRESS SENSING OPTION; THE TWO MEASUREMENT CHANNELS COULD ALSO BE COMBINED IN A SINGLE GAGE BODY PACKAGE. FIELD DATA RECORDING COST AND SYSTEM PROBLEMS WOULD BE MINIMIZED BY STAYING WITH THE ELECTRICAL CONFIGURATION OF A CONVENTIONAL LOW-VOLTAGE STRAIN GAGE BRIDGE (PER CHANNEL). THE

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NATURE OF THE DESIGN INHERENTLY MINIMIZES UNWANTED AMBIGUITIES WITH OTHER STRESS COMPONENTS. THE SMALL SIZE AND FAVORABLE SHAPE OF THE INTERNAL STRUCTURE MINIMIZES AND FACILITATES CORRECTIONS FOR WAVE PROPAGATION EFFECTS WITHIN THE GAGE. A CHALLENGING MINIATURIZED STRAIN GAGING REQUIREMENT IS INVOLVED, AND A SIGNIFICANT PART OF THE PHASE I EFFORT WOULD BE TO DEVELOP THE TECHNIQUE REQUIRED.

INTELLIGENT SYSTEMS INTEGRATION INC  
2120 FATHER SKY NE  
ALBUQUERQUE, NM 87112  
CONTRACT NUMBER:  
DR TIMOTHY J ROSS  
TITLE:  
DEVELOPMENT OF AN EULERIAN FINITE ELEMENT CODE  
TOPIC# 1                      OFFICE: DNA

CURRENT NUMERICAL COMPUTATIONS TO DESCRIBE NUCLEAR GROUND SHOCK ENVIRONMENTS, NUCLEAR CRATER FORMATION, IMPACT DYNAMICS AND PENETRATION MECHANISMS PRESENTLY EMPLOY EULERIAN-BASED FINITE DIFFERENCE CODES BECAUSE OF THEIR ABILITY TO MODEL THE MASS FLUX PHENOMENA IN TRACKING MATERIAL MOVEMENT THROUGH THE DISCRETIZED SPACE. THE FINITE DIFFERENCE CODES SUFFER IN COMPARISON TO FINITE ELEMENT CODES, HOWEVER, IN THEIR ABILITY TO TREAT IRREGULAR GEOMETRIES AND VARIATIONS IN BOTH MESH SIZE AND ELEMENT SHAPE. BUT, BECAUSE FINITE ELEMENT CODES ARE LAGRANGIAN-BASED, MODELING OF MASS FLOW IS EXCEEDINGLY DIFFICULT AND IS NOT PRESENTLY PRACTICED. THIS PROBLEM CAN BE OVERCOME BY ELIMINATING THE INABILITY OF FINITE ELEMENT CODES TO ACCOMMODATE MASS FLUX PHENOMENA.

IRT CORP  
3030 CALLAN RD  
SAN DIEGO, CA 92121  
CONTRACT NUMBER:  
JOSEPH L AZAREWICZ  
TITLE:  
TEMPERATURE DEPENDENCE OF LATCHUP  
TOPIC# 5                      OFFICE: DNA

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RECENT TESTS AT IRT CORPORATION THAT WERE PERFORMED ON ADVANCED SCHOTTKEY LOGIC DEVICES HAVE PRODUCED SOME ANOMALOUS RESULTS. DURING ROUTINE LATCHUP TESTS, LATCHUP WAS OBSERVED IN SOME OF THE DEVICES WHEN TESTED AT ROOM TEMPERATURE. HOWEVER, WHEN THE TEMPERATURE OF THE TEST WAS ELEVATED, LATCHUP DID NOT OCCUR IN SOME OF THE DEVICES WHICH HAD LATCHED AT ROOM TEMPERATURE. THIS RESULT IS CONTRARY TO WHAT THEORY WOULD PREDICT. THIS IS AN EXTREMELY IMPORTANT RESULT SINCE CURRENT TEST PROCEDURES REQUIRE THAT LATCHUP TESTS BE PERFORMED AT ELEVATED TEMPERATURES TO SIMULATE WORST CASE CONDITIONS. THIS PROPOSAL DESCRIBES A PROGRAM WHICH ADDRESSES THE ANOMALOUS LATCHUP BEHAVIOR AND ATTEMPTS TO DEFINE THE MECHANISM WHICH HAS CAUSED THIS BEHAVIOR.

MISSION RESEARCH CORP  
ONE TARA BLVD - STE 302  
NASHUA, NH 03062  
CONTRACT NUMBER:  
RUSSELL A ARMSTRONG  
TITLE:  
CONCEPT FOR NUCLEAR-RELATED ATMOSPHERIC OPTICAL/INFRAR  
MEASUREMENTS PROGRAM (POLARS)  
TOPIC# 2 OFFICE: DNA

A CONCEPT FEASIBILITY STUDY FOR A SATELLITE-BASED OPTICAL-INFRARED DISTURBED ATMOSPHERE SIGNATURE PROGRAM IS PROPOSED. THE INITIAL CONCEPT IS FOR A POLAR-ORBITING OPTICAL-INFRARED ANALOG TO THE HILAT SATELLITE WHERE-IN A HIGH PROBABILITY OF AURORAL ACQUISITION IS ANTICIPATED. INITIAL TECHNICAL DIFFICULTIES OF CRYOGENIC OPERATION AND EXPECTED LIFETIME ARE DISCUSSED IN TERMS OF THE IRAS SUCCESS. THE CONCEPT FOR CORRELATED EXPERIMENTS OF AIRCRAFT AND GROUND-BASED OBSERVATIONS OF AURORA AND/OR A CHEMICAL RELEASE ARE INTRODUCED AND INCLUDE STRUCTURE INFORMATION. THE DATA-BASE POTENTIAL OF SUCH A CONCEPT EXCEEDS THE TOTAL DATA PRESENTLY AVAILABLE TO DNA NWE ATMOSPHERIC-EFFECTS MODELLERS, AND REPRESENTS A MUCH BROADER STATISTICAL SAMPLING THAN ROCKET-BASED EXPERIMENTS.

MISSION RESEARCH CORP  
PO DRAWER 719 - 735 STATE ST  
SANTA BARBARA, CA 93102  
CONTRACT NUMBER:  
DR THADDEUS J MAZUREK  
TITLE:  
EXPANSION OF NUCLEAR BURST DEBRIS IN THE MAGNETIC CONF  
REGIME  
TOPIC# 2 OFFICE: DNA

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SDI SYSTEMS DESIGN AND OPERATIONS CAN BENEFIT FROM A BETTER UNDERSTANDING OF THE NUCLEAR PHENOMENOLOGY AT BURST ALTITUDES AROUND 1500 KM. SALVAGE FUZING OF INTERCEPTED WARHEADS COULD PRODUCE NUCLEAR EXPLOSIONS AT THESE ALTITUDES. KNOWLEDGE OF THE RESULTING NUCLEAR ENVIRONMENT CAN BE USED TO IMPROVE SDI SYSTEMS PERFORMANCE. FOR BURST ALTITUDES AROUND 1500 KM, EXPANDING DEBRIS IS EXPECTED TO SLOW PREDOMINATELY BY MAGNETIC FORCES. THEORETICAL UNDERSTANDING OF NUCLEAR BURSTS IN THIS MAGNETIC CONFINEMENT REGIME IS VERY LIMITED BECAUSE EXISTING TEST DATA IS AT MUCH LOWER ALTITUDES. STUDY OF DEBRIS EXPANSION HERE COULD BE PURSUED VIA AN AXISYMMETRIC, THREE DIMENSIONAL, HYBRID (ELECTRON FLUID/ION PARTICLES) CODE TO EXAMINE WAVE-PARTICLE INSTABILITIES, IN COMBINATION WITH A PROCEDURE FOR INCLUDING THEIR EFFECTS IN FASTER MHD FLUID-LIKE CALCULATIONS. TO PREPARE GROUNDWORK FOR SUCH STUDY, THE PHASE I OBJECTIVES ARE: (1) TO ESTIMATE PHYSICAL PARAMETER RANGES VIA MHD CALCULATION OF THE MAGNETIC BUBBLE SHAPE AND TIME TO ITS MAXIMUM EXPANSION; (2) TO DESIGN AN AXISYMMETRIC HYBRID PLASMA TREATMENT AND DETERMINE LIMITS ON APPLICABILITY TO COUPLING SHELL EXPANSION; AND (3) TO EXAMINE THE PRACTICALITY OF A TRUNCATED MOMENT METHOD FOR INCLUDING WAVE-PARTICLE EFFECTS IN MHD APPROACHES.

MISSION RESEARCH CORP  
PO DRAWER 719 - 735 STATE ST  
SANTA BARBARA, CA 93102

CONTRACT NUMBER:

DR WILLARD W WHITE

TITLE:

A FIRST PRINCIPLE APPROACH TO MULTIPLE HIGH-ALTITUDE N  
EXPLOSIONS

TOPIC# 2

OFFICE: DNA

ENVIRONMENTAL DISTURBANCES PRODUCED BY HIGH-ALTITUDE NUCLEAR DETONATIONS ARE WIDESPREAD AND PERSISTENT. DATA FROM ATMOSPHERIC TESTS (LATE 50'S, EARLY 60'S) PLUS EXTENSIVE RESEARCH EFFORTS ARE THE BASIC FOR UNDERSTANDING THE NUCLEAR ENVIRONMENT AND RESULTANT SYSTEMS EFFECTS. HOWEVER, ALL NUCLEAR TESTS AND MOST SUBSEQUENT BASIC RESEARCH HAVE INVOLVED ONLY SINGLE EXPLOSIONS. BALLISTIC MISSILE DEFENSE ISSUES CONSIDERED BY THE STRATEGIC DEFENSE INITIATIVE ORGANIZATION (SDIO) INCLUDE DISTURBED ENVIRONMENTS PRODUCED BY

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NUMEROUS HIGH-ALTITUDE NUCLEAR EXPLOSIONS. MULTIPLE EXPLOSIONS MAY BE AN INTEGRAL PART OF MISSILE DEFENSE, RESULT FROM A SALVAGE-FUSED WEAPONS, OR BE AN OFFENSIVE TACTIC TO SUPPRESS SENSORS, DEFENSIVE WEAPONS, OR COMMUNICATIONS. PRESENT CAPABILITIES TO SIMULATE HIGH-ALTITUDE NUCLEAR DETONATIONS ON A PHYSICS-BASED "FIRST-PRINCIPLES" LEVEL ARE LIMITED TO SINGLE EXPLOSIONS AND TO A LIMITED CLASS OF MULTIPLE DETONATIONS. IT IS WELL KNOWN THAT NON-LINEAR INTERACTIONS BETWEEN MULTIPLE EXPLOSIONS PRECLUDE ARBITRARY SUPERPOSITION OF SINGLE-BURST PHENOMENA, BUT THERE IS NO COMPREHENSIVE FIRST-PRINCIPLES CAPABILITY TO CALCULATE THESE COMPLEX EFFECTS. THIS PROPOSAL SEEKS TO INITIATE AN EFFORT TO CORRECT THIS DEFICIENCY.

MISSION RESEARCH CORP  
4935 N 30TH ST  
COLORADO SPRINGS, CO 80919  
CONTRACT NUMBER:  
ROBERT A RACCA

TITLE:

EXAMINATION OF R-WIRE BURST USING A HYDRODYNAMIC MODEL  
TOPIC# 5                      OFFICE: DNA

STUDIES WILL BE PERFORMED TO EXAMINE THE FEASIBILITY OF USING FAIRLY HIGH RESISTANCE CABLES (R-WIRES) AS A MEANS TO MITIGATE THE LARGE SREMP TRANSIENTS WHICH ARE EXPECTED IN BURIED AND OVERHEAD POWER-LINE DISTRIBUTIONS. THE ANALYSIS WILL UTILIZE COMPUTER CODES WHICH SOLVE THE ONE-DIMENSIONAL TRANSMISSION LINE EQUATIONS IN THE TIME DOMAIN USING FINITE DIFFERENCE TECHNIQUES. A MAJOR PORTION OF THIS EFFORT WILL BE DIRECTED TOWARDS THE INCORPORATION OF A HYDRODYNAMIC MODEL WITHIN THE FRAMEWORK OF THE 1-D CODES TO DESCRIBE THE BEHAVIOR OF THESE RESISTIVE CABLES UNDER ELECTRICAL STRESS. A SUFFICIENTLY LARGE AMOUNT OF ENERGY INJECTED INTO THE CABLE WILL RESULT IN VAPORIZATION OF THE MATERIAL AND SUBSEQUENT FORMATION OF A LOW RESISTANCE "RE-STRIKE ARC." EARLIER STUDIES OF RESISTIVE CABLES EMPLOYED A SIMPLE JOULE HEATING MODEL WITHIN THE 1-D CODES. THE PROPOSED STUDY WILL CAREFULLY EXAMINE THE VAPORIZATION AND RESTRIKE PHENOMENON USING THE MORE SOPHISTICATED HYDRODYNAMIC MODEL TO DESCRIBE THESE EFFECTS.

QUAN-SCAN INC  
77 N OAK KNOLL AVE - #109  
PASADENA, CA 91101  
CONTRACT NUMBER:  
DR PAUL E WEST

TITLE:

MICRO DIGITAL RECORDING MODULE FOR NUCLEAR WEAPONS TESTS  
TOPIC# 3                      OFFICE: DNA

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THE DEFENSE NUCLEAR AGENCY SEEKS NEW INSTRUMENTATION USING STATE-OF-THE-ART TECHNOLOGY FOR IMPROVED DATA COLLECTION WITH BETTER ACCURACY AT LOWER COST. LARGE AMOUNTS OF DATA MUST BE RECORDED TO CHARACTERIZE THE EFFECTS OF NUCLEAR WEAPONS TESTS. QUANSCAN PROPOSES TO APPLY CONCEPTS RECENTLY PROVEN FOR THE SCANNING TUNNELING MICROSCOPE TO STUDY THE FEASIBILITY OF DEVELOPING A NEAR SOLID STATE MASS STORAGE SYSTEM THAT WILL STORE APPROXIMATELY 440 GIGABITS ON A SURFACE OF ONE SQUARE CENTIMETER. SUCH A MASS STORAGE SYSTEM WOULD BE SMALL, DENSER THAN ANYTHING CURRENTLY ACHIEVED, NONVOLATILE, RADIATION HARDENED, AND CONSUME LOW POWER.

RESTECH INC  
14411 CORNERSTONE VILLAGE DR  
HOUSTON, TX 77014  
CONTRACT NUMBER:  
ROBERT P ALGER  
TITLE:  
EVALUATION OF WELL LOG DATA FOR DETERMINATION OF AIR A  
GAS FILLED POROSITY  
TOPIC# 1                      OFFICE: DNA

A PHYSICAL PROPERTY OF EARTH FORMATIONS THAT STRONGLY INFLUENCES THE RATE OF ATTENUATION OF A SHOCK WAVE IS THE BULK VOLUME OF AIR OR GAS ENTRAINED IN THE POROSITY. AS A RESULT, THE ACCURATE DETERMINATION OF THIS GAS VOLUME IS IMPORTANT FOR PREDICTING THE EFFECT OF A SHOCK WAVE ON SUBSURFACE STRUCTURES. THE OIL AND GAS INDUSTRY HAS USED GEOPHYSICAL WELL LOGS FOR YEARS TO IDENTIFY AND EVALUATE THE VOLUME OF OIL AND GAS IN SUBSURFACE FORMATIONS. IN THE PAST, THE TECHNIQUES UTILIZED BY THE OIL AND GAS INDUSTRY HAS NOT BEEN OF SUFFICIENT ACCURACY FOR USE IN SHOCK ATTENUATION STUDIES. RECENT DEVELOPMENTS IN LOG MEASUREMENTS, PREPROCESSING, QUALITY CONTROL, DATA INTEGRATION, AND MODELING HAS GREATLY IMPROVED THE ACCURACY OF DETERMINING LOW VOLUMES OF GAS AT LOW POROSITIES. WELL LOG DATA FROM AN AREA IN THE ILLINOIS BASIN WILL BE EVALUATED TO DETERMINE IF THESE RECENT DEVELOPMENTS ARE OF SUFFICIENT MAGNITUDE THAT THE RESULTS WILL BE USEFUL TO DNA.

SCA RESEARCH INC  
3450 LILLY AVE  
LONG BEACH, CA 90808  
CONTRACT NUMBER:  
RICHARD D NUTTALL  
TITLE:  
OPERATIONAL PLANNING AND FORCE STRUCTURE  
TOPIC# 7                      OFFICE: DNA



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THE OBJECTIVE OF THIS STUDY IS TO RESEARCH, ANALYZE, AND ASSESS FORCE STRUCTURE AND OPERATIONAL PLANNING ISSUES RELATED TO THE DEPLOYMENT OF LONG RANGE, PRECISION GUIDED, LOW YIELD NUCLEAR WEAPONS FOR THE FULL RANGE OF POTENTIAL CONFLICT SITUATIONS, INCLUDING STRATEGIC, REGIONAL, AND LIMITED WARS. THE MAJOR THRUSTS ARE: (1) TO ANALYZE THROUGH THE USE OF SCENARIOS, MISSION ANALYSIS, AND NATIONAL SECURITY STRATEGY THE BENEFITS AND WORTH-WHILE ROLES FOR THESE LONG RANGE DELIVERY SYSTEMS, (2) TO SIMPLIFY THE PRESENTATION OF THE TECHNICAL MILITARY UTILITY ASPECTS OF THESE WEAPONS SO THAT THEY WILL BE WELL UNDERSTOOD BY PEOPLE AT ALL LEVELS OF THE DECISION MAKING PROCESS, AND (3) TO PROVE THE SCIENTIFIC AND TECHNICAL FEASIBILITY OF THE PHASE I EFFORT SO THAT IT WILL LEAD INTO PHASE II.

SCIENCE & ENGINEERING ASSOCS INC  
PO BOX 3722  
ALBUQUERQUE, NM 87190  
CONTRACT NUMBER:  
ROBERT L DuBOIS  
TITLE:  
NUCLEAR SURVIVABILITY AWARENESS AND TRAINING  
TOPIC# 5                      OFFICE: DNA

THE INTENT OF DOD INSTRUCTION 4245.4, "ACQUISITION OF NUCLEAR SURVIVAL SYSTEMS" IS TO PROVIDE FOR NUCLEAR SURVIVABILITY THROUGHOUT THE LIFE CYCLE OF WEAPON SYSTEMS WHICH ARE REQUIRED TO SURVIVE THE EFFECTS OF NUCLEAR WEAPONS. ONE KEY TO IMPLEMENTING THIS INTENT IS TO INSURE THAT ALL THE PEOPLE INVOLVED ARE FAMILIAR WITH THEIR RESPONSIBILITIES TO IMPLEMENT AND PRESERVE THIS SURVIVABILITY. THIS STUDY WILL PROVIDE THE FOUNDATION FOR EFFECTIVE AND EFFICIENT AWARENESS AND TRAINING COURSES. IT WILL IDENTIFY AND EVALUATE EXISTING COURSES; DETERMINE THE TYPES OF AUDIENCES WHICH NEED TRAINING; RECOMMEND WHO SHOULD PROVIDE COURSES; AND SUGGEST COURSE CONTENTS.

SPARTA INC  
23293 S POINTE DR  
LAGUNA HILLS, CA 92653  
CONTRACT NUMBER:  
BURTON S CHAMBERS III  
TITLE:  
LARGE 3-D ARCHITECTURE FOR PARALLEL PROCESSORS  
TOPIC# 1                      OFFICE: DNA

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THERE EXISTS A NEED FOR ANALYSIS OF NUCLEAR-WEAPON ENVIRONMENTS AND THEIR EFFECTS ON MILITARY SYSTEMS. IMPROVEMENTS IN PERFORMANCE OF COMPUTATIONAL TOOLS ARE NEEDED. HEREIN IS PRESENTED AN INNOVATIVE IDEA FOR PRODUCING SUCH AN IMPROVEMENT; IT WILL TAKE ADVANTAGE OF PARALLEL PROCESSORS. THE IMPORTANCE OF THIS WORK IS TO DEMONSTRATE AN APPROACH TO IMPROVE THE FIDELITY OF CALCULATIONS AND REDUCE THEIR COSTS. THIS PROPOSAL ADDRESSES AN INNOVATION THAT CAN BE APPLIED TO SOLVING THE NUMERICAL DIFFERENCEING EQUATIONS THAT REPRESENT THE DIFFERENTIAL EQUATIONS OF FLUID FLOW PHENOMENA. THIS SOLUTION SCHEME IS EXPECTED TO HAVE WIDESPREAD APPLICABILITY TO BOTH EXISTING AND FUTURE COMPUTER PROGRAMS (CODES). THE SAVINGS IN COMPUTER TIME, WHEN USING THIS APPROACH WITH TYPICAL VECTOR PROCESSORS, WILL BE QUITE SIGNIFICANT. IT IS THESE SAVING THAT ARE IMPORTANT AND RELEVANT. IF SUBSTANTIAL, THEY WILL, FOR EXAMPLE, ALLOW USE OF BETTER CELL RESOLUTION THAT CAN, IN TURN, IMPROVE SOLUTION ACCURACY. FURTHER, AS DNA SHIFTS ITS WORK LOAD (ASSOCIATED WITH SOLVING THEIR COMPUTATIONAL FLUID DYNAMICS PROBLEMS) TO COMPUTERS WITH ADVANCED PARALLEL PROCESSING CAPABILITIES, THESE SAVINGS SHOULD INCREASE EVEN FURTHER.

SUNOL SCIENCES CORP  
6400 VILLAGE PKWY  
DUBLING, CA 94568  
CONTRACT NUMBER:  
PATRICK S SPANGLER

TITLE:  
A FAST AND SIMPLE METHOD FOR COMPUTING THE EFFECTS OF  
IMPULSE  
TOPIC# 2                      OFFICE: DNA

AN ANALYTIC MODEL IS DEVELOPED FOR COMPUTING THE BLOWOFF IMPULSE DISTRIBUTION ON SMALL BODIES. CORRELATIONS ARE MADE BETWEEN MODEL PREDICTIONS AND UGT DATA. THE MODEL IS SIMILAR IN PHYSICAL BASIS, SPEED, AND SIMPLICITY TO THE BBAY FORMULATION FOR ONE-DIMENSIONAL BLOWOFF IMPULSE. AN GT AND UGT EXPERIMENT TECHNIQUE IS DEVELOPED SPECIFICALLY TO SUBSTANTIATE THE TWO-DIMENSIONAL MODELS AND TO PROVIDE DATA ON TWO-DIMENSIONAL BLOWOFF FROM SELECTED MATERIALS.

TECHNOLOGY DEVELOPMENT ASSOCS INC  
992 OLD EAGLE SCHOOL RD - STE 910  
WAYNE, PA 19087  
CONTRACT NUMBER:  
DENISE A FOEDINGER  
TITLE:  
DEVELOPMENT OF A PERSONAL COMPUTER CODE FOR ENERGY DEP  
ANALYSES  
TOPIC# 5                      OFFICE: DNA

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CONVENTIONAL NUCLEAR HARDENING AND SURVIVABILITY COMPUTER CODES ARE CURRENTLY IMPLEMENTED ON LARGE MAINFRAME COMPUTER SYSTEMS SUCH AS THE CRAY, IBM, AND THE VAX. TRANSFERRING THESE CODES TO A PERSONAL COMPUTER COULD PROVIDE A MUCH MORE EFFICIENT OPERATING SYSTEM ENVIRONMENT IN THAT SIMPLE ENERGY DEPOSITION ANALYSES FOR EXAMPLE COULD BE PERFORMED "ON-SITE" AND THE COSTS ASSOCIATED WITH FILE STORAGE AND TIME SHARING ON A MAINFRAME COMPUTER SYSTEM WOULD BE ELIMINATED. THE PROPOSED PHASE I PROGRAM SHALL DEVELOP AN ENERGY DEPOSITION CODE WHICH CAN BE UTILIZED ON A PERSONAL COMPUTER.

TERRA TEK INC  
400 WAKARA WY  
SALT LAKE CITY, UT 84108  
CONTRACT NUMBER:  
BENNIE G DiBONA  
TITLE:  
THE EFFECT OF PRESHOCK LOADING ON THE RESPONSE OF NTS  
TOPIC# 1                      OFFICE: DNA

PRESHOCKED PRECONDITIONING OF TUFF MAY OCCUR IN TWO MANNERS AT THE NEVADA TEST SITE. FIRST, THE MATERIAL IS "PRESHOCKED" IN A LINE-OF-SIGHT TYPE UNDERGROUND NUCLEAR TEST BY THE FIRST WAVE PASSAGE. THE SECOND MANNER MAY OCCUR AS A RESULT OF AREAL SPACE LIMITATIONS WHEN A SECOND EVENT IS SITED WITHIN A REGION OF PRESHOCKED MATERIAL. UNDER CERTAIN LOAD-UNLOADED CONDITIONS THE MATERIAL STRENGTH MAY BE VERY MUCH REDUCED FOR SUBSEQUENT LOADING. A LARGE LOSS OF STRENGTH DUE TO PRESHOCKING COULD SIGNIFICANTLY INFLUENCE THE EFFECTIVENESS OF STEMMING AND CONTAINMENT. A TEST PROGRAM IS PROPOSED TO PROVIDE FOR A BETTER UNDERSTANDING OF THE EFFECT OF PRELOADING (LOAD AND UNLOAD) ON THE MICROMECHANICS OF MATERIAL LOADING AND THE SUBSEQUENT MATERIAL RESPONSE.

TERRA TEK INC  
420 WAKARA WY  
SALT LAKE CITY, UT 84108  
CONTRACT NUMBER:  
WILLIAM KLAUBER  
TITLE:  
UNDRAINED SHEAR BEHAVIOR OF SATURATED JOINTED ROCKS AT  
CONDITIONS  
TOPIC# 1                      OFFICE: DNA

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SHEAR DISPLACEMENT ALONG ROCK MASS DISCONTINUITIES (JOINTS) UNDER SATURATED, UNDRAINED CONDITIONS IS ONE OF THE CRITICAL FAILURE MODES FOR A DYNAMICALLY LOADED DEEP BASE STRUCTURE. THE FAILURE MODE HAS NOT BEEN EXPERIMENTALLY SIMULATED FOR DEEP BASE CONDITIONS. THE COMBINED APPLICATION OF NORMAL AND SHEAR STRESSES AT DYNAMIC RATES, WITHOUT PORE PRESSURE DRAINAGE, IS LIKELY TO PRODUCE HIGH PORE PRESSURES FOR ANY OVERPRESSURE IN WHICH THE JOINT NORMAL CLOSURE EXCEEDS SHEAR-INDUCED NORMAL DILATION. THIS SYNERGISTIC EFFECT OF SIMULTANEOUS SHEAR AND NORMAL LOADING WITHOUT DRAINAGE IS IMPORTANT IN ROCK TYPES CONSIDERED FOR SITING DEEP BASED STRUCTURES, SPECIFICALLY IN WEAK, POROUS ROCKS. THE OBJECTIVE OF THIS RESEARCH IS TO INVESTIGATE PORE PRESSURE RELATED STRENGTH DEGRADATION AT AN APPROPRIATE OVERPRESSURE LEVEL AND DYNAMIC RISE TIME OF INTEREST FOR DEEP BASING TO PROVE FEASIBILITY FOR DETAILED DEFINITION OF THE PHENOMENON IN PHASE II. PHASE I EXPERIMENTAL WORK INVOLVES 24 SHEAR TESTS, WHICH VARY DRAINAGE, STRAIN RATE, ROCK TYPE, AND JOINT ROUGHNESS TO SCOPE OUT THE FACTORS WHICH ARE CRITICAL FOR DYNAMIC, SATURATED SHEAR STRENGTH.

UTD INC  
8220 RUSSELL RD  
ALEXANDRIA, VA 22309  
CONTRACT NUMBER:  
DR EUGENE L FOSTER  
TITLE:  
TUNNEL HARDENING THROUGH INNOVATIVE ROCK BOLTS AND SHO  
TOPIC# 5                      OFFICE: DNA

DEEP BASING FACILITIES REQUIRE THAT STRUCTURES BE PROTECTED AGAINST BLAST EFFECTS. INHERENT IN THIS NEED IS FOR THE TUNNEL SUPPORT SYSTEM TO BE ECONOMICALLY INSTALLED AND CAPABLE OF WITHSTANDING OVERSTRESSES WHICH MAY REACH OR EXCEED 1 KILOBAR. IN ORDER TO MORE EFFICIENTLY HARDEN A STRUCTURE, THE SUPPORT SYSTEM SHOULD BE MADE MORE DUCTILE SO THAT IT CAN UNDERGO DEFORMATION WHILE RETAINING ITS ABILITY TO RESIST LOADING. ONCE CONCEPT FOR DEVELOPING THIS DUCTILITY IS THE USE OF INNOVATIVE ROCK BOLTS AND SHOTCRETE LINERS. PATTERNED ROCK BOLTS AND SHOTCRETE ARE GENERALLY MORE ECONOMICAL THAN MONOLITHIC CONCRETE WITH FRANGIBLE BACKPACKING, HOWEVER, TESTING HAS LIMITED THEIR EFFECTIVENESS TO THE 1/4 KBAR RANGE. THEREFORE,

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THE NEED EXISTS TO DEVELOP A ROCK BOLT - SHOTCRETE LINING SYSTEM WHICH PROVIDES GREATER LEVELS OF HARDNESS BUT REMAINS MORE ECONOMICAL THAN THE CAST-IN-PLACE CONCRETE LINERS. THIS ANALYSIS WILL DEVELOP THIS SYSTEM.

VISIDYNE INC  
10 CORPORATE PL - SO BEDFORD ST  
BURLINGTON, MA 01803  
CONTRACT NUMBER:  
WILLIAM P REIDY  
TITLE:  
IMPULSIVE COLD CATHODE PHOTOELECTRON ACCELERATOR  
TOPIC# 2                      OFFICE: DNA

THIS IS A FEASIBILITY STUDY TO EVALUATE THE DEVELOPMENT OF A TECHNIQUE FOR RAPID DEPOSITION OF ENERGY IN THE UPPER ATMOSPHERE AT LEVELS COMPARABLE WITH MEGATON DETONATIONS AT 200 KILOMETERS TO PROVIDE BASELINE DATA FOR PREDICTING INFRARED EMISSIONS FROM HIGH ALTITUDE NUCLEAR DETONATIONS. PREVIOUS MEASUREMENTS UTILIZED PULSES OF ELECTRONS LASTING SEVERAL SECONDS. IN ORDER TO ACHIEVE HIGHER ENERGY DEPOSITION PER UNIT VOLUME AND HIGHER IONIZATION LEVELS OVER A RANGE OF MEASUREMENT ALTITUDES AND TO MORE CLOSELY APPROXIMATE THE NUCLEAR CASE, PULSES WHICH ARE MUCH SHORTER IN TIME AND HIGHER IN POWER ARE NEEDED. UNDER THE PROPOSED PROJECT, THE TECHNICAL FEASIBILITY OF AN IMPULSIVE DEPOSITION TECHNIQUE USING BEAMS OF ELECTRONS EMITTED FROM FLASHLAMP-DRIVEN PHOTOCATHODES WILL BE ANALYZED AND DEMONSTRATED IN THE LABORATORY. A CONCEPTUAL DESIGN OF A SOUNDING ROCKET PAYLOAD WILL BE PREPARED. PRELIMINARY ESTIMATES INDICATE THAT THE SIZE AND WEIGHT OF THE IMPULSIVE DEPOSITION PAYLOAD ARE COMPARABLE TO THE EXCEDE III PAYLOAD.

DNA

TOTAL NUMBER OF AWARDS: 25

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3C SYSTEMS INC  
620 ARGYLE RD  
WYNNEWOOD, PA 19096  
CONTRACT NUMBER:  
MURRAY KORNHAUSER  
TITLE:  
HIGH-GRAVITY STRUCTURE DURATION TESTS  
TOPIC# 2                      OFFICE:

INSTRUMENTATION OF HIGH-ACCELERATION STRUCTURES BEING TESTED IN LONG DURATION SHOCK FACILITIES SUCH AS AIR GUNS AND LIGHT GAS GUNS ALWAYS HAS BEEN EXTREMELY DIFFICULT BECAUSE OF THE GREAT DISTANCES THE TEST ITEM MUST MOVE DURING THE TEST. A SHORT-DURATION, HIGH-ACCELERATION SHOCK TESTER IS UNDER DEVELOPMENT, AND THE TEST ITEM MOTIONS OF LESS THAN SIX INCHES WILL PERMIT HARD-WIRE INSTRUMENTATION FOR MONITORING STRESSES, STRAINS AND COMPONENT PERFORMANCE DURING AND AFTER THE LOADING PERIOD. HOWEVER, CONCERNS HAVE BEEN EXPRESSED THAT ONE SHORT DURATION PULSE DOES NOT SIMULATE THE GUN LAUNCHING PROFILE (THEREBY PRODUCING A DIFFERENT STRUCTURAL RESPONSE OR AMPLIFICATION FACTOR), AND THAT THERE MAY NOT BE ENOUGH KINETIC ENERGY IN THE SHORT DURATION TEST TO PRODUCE LARGE STRAIN FAILURES WHEN YIELD STRENGTHS HAVE BEEN EXCEEDED. TESTS OF HIGH-ACCELERATION INSTRUMENTED STRUCTURES ARE BEING PERFORMED WITH THE SHORT DURATION SHOCK TESTER AND WITH GUNS UNDER CONDITIONS THAT MORE NEARLY SIMULATE LAUNCHING PROFILES. TESTING AND ANALYSIS PROCEDURES ALSO ARE BEING DEVELOPED FOR FUTURE EMPLOYMENT OF THE SHORT DURATION TESTER IN DEVELOPING KINETIC ENERGY STRUCTURES.

ACCELERATED TECHNOLOGY INC  
1852 CENTURY PL - STE 130  
ATLANTA, GA 30345  
CONTRACT NUMBER:  
ROD PRICE  
TITLE:  
SIGNAL PROCESSING TECHNIQUE FOR OPTICAL TARGET DISCRIM  
TOPIC# 3                      OFFICE:

IN MANY CIVILIAN AND MILITARY APPLICATIONS OF INFRARED SENSORS, THERE IS A NEED TO BE ABLE TO CLASSIFY OBJECTS IN THE SENSOR'S FIELD OF

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VISION AND DISCRIMINATE BETWEEN THEM. THE INFORMATIONAL NEEDS OF DISCRIMINATION SYSTEMS SEEM TO HAVE SHIFTED WITH THE USE OF PASSIVE SENSORS. UNLIKE RADAR SIGNALS, SIGNALS FROM PASSIVE SENSORS ARE BASICALLY NONPERIODIC; THUS, INFORMATION IS NOT EASILY EXTRACTED FROM THE FREQUENCY DOMAIN. THIS MAY MAKE TRADITIONAL SAMPLING ANALOG-TO-DIGITAL SIGNAL CONVERTERS INEFFICIENT. AN INNOVATIVE APPROACH TO ANALOG-TO-DIGITAL SIGNAL CONVERSION IS BEING INVESTIGATED THAT APPEARS VERY PROMISING WHEN USED WITH PASSIVE SENSOR SYSTEMS, FOR EXAMPLE, INFRARED CAMERAS. SUCH AN APPROACH WOULD GENERATE BETTER INFORMATION FOR DISCRIMINATION ALGORITHMS, IMPROVE THE DISCRIMINATION PROCESS, AND USE LESS COMPLICATED CIRCUITRY. MANY CIVILIAN APPLICATIONS OF SENSOR SYSTEMS HAVE THE NEED FOR DISCRIMINATION SYSTEMS THAT ARE SIMILAR TO THOSE USED IN MILITARY APPLICATIONS. AUTOMATED DISCRIMINATION IS USED IN BLOOD CELL COUNTERS, NUCLEAR MAGNETIC RESONANCE SYSTEMS AND OTHER FORMS OF MEDICAL DIAGNOSTIC IMAGING. DISCRIMINATION AND OBJECT RECOGNITION ALSO PLAY A LARGE ROLE IN AREAS LIKE ROBOT VISION, INDUSTRIAL PROCESS CONTROL AND AUTOMATED QUALITY CONTROL.

ADELPHI TECHNOLOGY INC  
532 EMERSON ST  
PALO ALTO, CA 94301  
CONTRACT NUMBER:  
MELVIN A PIESTRUP

TITLE:

X-RAY FREE ELECTRON LASER LOADED WITH PERIODIC DIELECT

TOPIC# 1

OFFICE:

IN A CONVENTIONAL FREE ELECTRON LASER (FEL), THE SIGNAL-GAIN DOES NOT IMPROVE WITH SHORTER WAVELENGTH, AND EXCESSIVELY LONG WIGGLERS AND HIGH CURRENTS ARE NEEDED TO OBTAIN SUFFICIENT GAINS FOR OPERATION. A FREE ELECTRON LASER THAT UTILIZES A PERIODIC DIELECTRIC TO COUPLE THE ELECTROMAGNETIC RADIATION TO THE ELECTRONS OFFERS AN ALTERNATIVE METHOD FOR SHORT WAVELENGTH OPERATION. AMPLIFICATION OF X-RAYS IN A PERIODIC MEDIUM BY AN ELECTRON BEAM IN A PERIODIC, TRANSVERSE, STATIC MAGNETIC FIELD IS BEING INVESTIGATED. BOTH EXPERIMENTAL AND THEORETICAL RESULTS SHOW THAT SUCH A DEVICE IS POSSIBLE. LOADING A FREE-ELECTRON LASER WITH A PERIODIC DIELECTRIC MODIFIES THE PHASE MATCHING CONDITION WHILE THE SMALL SIGNAL GAIN EXPRESSION REMAINS THE

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SAME WHEN WRITTEN IN THE APPROPRIATE FORM. THIS PERMITS A WIDER PARAMETER SELECTION THAN THE VACUUM FEL AND PROVIDES FOR THE POSSIBILITY OF SHORTER WAVELENGTH OPERATION. THE DEVICE IS A HYBRIDIZATION OF THE FEL AND THE STIMULATED-TRANSITION-RADIATION LASER. SCATTERING OF THE ELECTRONS AND PHOTON ABSORPTION BY THE PERIODIC MEDIUM LIMITS THE INTERACTION LENGTH, BUT CALCULATED GAINS ARE STILL HIGH ENOUGH FOR OSCILLATION. THE RESULTING X-RAY LASER WOULD BE EXTREMELY USEFUL ALSO IN SUCH DIVERSE APPLICATIONS AS DIAGNOSTIC MEDICINE, SUBMICRON LITHOGRAPHY, AND X-RAY MICROSCOPY.

ADROIT SYSTEMS INC  
809 N ROYAL ST  
ALEXANDRIA, VA 22314  
CONTRACT NUMBER:  
DAVID OBERG  
TITLE:  
DIRECTED ENERGY SYSTEM POINTING THROUGH GEOSYNCHRONOUS  
SATELLITE INTERFEROMETRY  
TOPIC# 1                      OFFICE:

CURRENT STUDIES CONCENTRATE ON GLOBAL POSITIONING SYSTEM (GPS) AS A SPACECRAFT ATTITUDE DETERMINATION TOOL. TWO GPS ANTENNAS RECEIVING THE SAME SIGNAL CAN COMPARE THEIR RELATIVE PHASES TO DETERMINE THE ANGLE BETWEEN THE TWO ANTENNAS AND THE GPS SATELLITE. BY COMPUTING THE ANGLE TO THREE OR MORE SATELLITES, THE COMPLETE INERTIAL ORIENTATION MAY BE DETERMINED. APPLYING ADVANCES IN GPS INTERFEROMETRY TO PRECISION POINTING OF DIRECTED ENERGY SYSTEMS LOCATED IN SPACECRAFT IS BEING INVESTIGATED. BY MEASURING THE ORIENTATION OF THE LASER ITSELF, MANY ERROR SOURCES SUCH AS GYROS, STAR TRACKERS, HORIZON SENSORS, GIMBAL PICK-OFFS, DEPLOYMENT MISALIGNMENT, AND STRUCTURAL BENDING MAY BE ELIMINATED OR REDUCED. THE RESULTING IMPROVEMENT IN POINTING ACCURACY DIRECTLY IMPROVES THE CHANCES OF HITTING AND DESTROYING THE TARGET, AND THUS IMPROVES THE UTILITY OF SPACE-BASED BALLISTIC MISSILE DEFENSE SYSTEMS. THE STUDY INCLUDES CONCEPT DEVELOPMENT, ERROR BUDGETING, AND TRADE-OFF ANALYSIS.

ADVANCED COMPOSITE PRODUCTS INC  
21 COMMERCE DR  
NORTH BRANFORD, CT 06471  
CONTRACT NUMBER:  
DAVID MAASS  
TITLE:  
THERMOPLASTIC COMPOSITES FOR LONG TERM SPACE APPLICATION  
TOPIC# 13                      OFFICE:



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THERMOPLASTIC COMPOSITE (TPC) MATERIALS OFFER SEVERAL BENEFITS FOR LONG-TERM SPACE APPLICATIONS. THEY ARE MORE RESISTANT THAN STATE-OF-THE-ART GRAPHITE/EPOXY TO THERMAL CYCLING INDUCED MICROCRACKS, RADIATION DAMAGE, IMPACT DAMAGE, AND DELAMINATION. FURTHERMORE, TPC'S CAN BE CONVENIENTLY AND DIRECTLY PLATED WITH METALS SUCH AS GOLD TO FORM PROTECTIVE BARRIERS AND CAN PROVIDE BETTER PASSIVE DAMPING THAN THERMOSETS LIKE GRAPHITE/EPOXY. A SUITABLE THERMOPLASTIC RESIN IS BEING SELECTED AND COMBINED WITH HIGH MODULUS GRAPHITE IN A NOVEL MANNER. THE RESULTING TPC MATERIAL IS BEING PLATED AND THEN CHARACTERIZED FOR THERMAL, PHYSICAL AND MECHANICAL PROPERTIES. A REPRESENTATIVE TUBULAR SECTION IS BEING FABRICATED AND PLATED AS A DEMONSTRATION OF THE MANUFACTURING METHODS SUITED FOR THESE MATERIALS. MANY OF THE PROPERTY IMPROVEMENTS INHERENT IN A TPC STRUCTURE LEAD TO ENHANCED RELIABILITY. RELIABLE STRUCTURES WITH LONG LIVES ARE ABSOLUTELY ESSENTIAL IF MAJOR DEFENSIVE WEAPONS SYSTEMS ARE TO BE MOUNTED ON THESE SPACE TRUSS STRUCTURES. IN ADDITION, LIFE CYCLE COSTS ARE LIKELY TO BE FAR LOWER BECAUSE OF REDUCED MAINTENANCE REQUIRED FOR THIS KIND OF MATERIAL (AND ASSOCIATED COST OF ON-ORBIT REFURBISHMENT).

ADVANCED COMPOSITE PRODUCTS INC  
21 COMMERCE DR  
NORTH BRANFORD, CT 06471  
CONTRACT NUMBER:  
DAVID MAASS  
TITLE:  
JOINTS DESIGN AND SCALING FOR LARGE SPACE-BASED STRUCT  
TOPIC# 12                      OFFICE:

A FIRM UNDERSTANDING OF THE SCALING RELATIONSHIPS OF SPACE TRUSS JOINTS INCREASES THE CONFIDENCE LEVEL IN SUBSCALE GROUND TESTING CURRENTLY PLANNED FOR ENGINEERING DEVELOPMENT AND QUALIFICATION OF LARGE SPACE STRUCTURES. USE OF SCALE MODELS SIGNIFICANTLY REDUCES DEVELOPMENT AND QUALIFICATION EXPENSE AND LEAD TIME ASSOCIATED WITH THESE KINDS OF LARGE TRUSS STRUCTURES. TO ADDRESS THIS ISSUE, THE INFLUENCE OF SEVERAL KEY VARIABLES ON THE SCALING PHENOMENA OF JOINTS FOR LIGHTWEIGHT TUBULAR TRUSS STRUCTURES IS BEING DERIVED THROUGH EMPIRICAL TESTING. THE VARIABLES INCLUDE SCALE FACTOR, JOINT FIT TOLERANCES, AND THE INFLUENCE OF THE JOINT MATERIAL. JOINT

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PERFORMANCE IS BEING CHARACTERIZED STATICALLY AND DYNAMICALLY. THE DEVELOPMENT OF AN INJECTION-MOLDED THERMOPLASTIC COMPOSITE FITTING COULD IMPROVE STRUCTURAL PERFORMANCE WHILE POTENTIALLY REDUCING UNIT COST SUBSTANTIALLY. TO ADDRESS THIS SECOND ISSUE, PRELIMINARY COMPARATIVE DATA IS BEING PROVIDED ON THE PERFORMANCE OF A CHOPPED-FIBER REINFORCED INJECTION MOLDING COMPOUND FOR USE AS A SPACE TRUSS JOINT MATERIAL. THIS THERMOPLASTIC COMPOSITE MATERIAL OFFERS SEVERAL IMPORTANT BENEFITS IN THIS APPLICATION: PRECISION TOLERANCES AND UNIT-TO-UNIT REPEATABILITY, REDUCED THERMAL MISMATCH WITH MATING COMPOSITE TUBES, LOWER WEIGHT AND DRAMATICALLY REDUCED RECURRING COSTS.

ADVANCED MATERIALS CORP

4400 FIFTH AVE

PITTSBURGH, PA 15213

CONTRACT NUMBER:

S G SANKAR

TITLE:

LOW-COST LIGHTWEIGHT HIGH TORQUE MOTORS FOR APPLICATION

WIDE TEMPERATURE RANGE

TOPIC# 6

OFFICE:

IRON-BASED RARE EARTH-BORON PERMANENT MAGNETS OF THE COMPOSITION  $Fe_{14}Nd_2B$  WHICH WERE DISCOVERED SEVERAL YEARS AGO POSSESS MAGNETIC ENERGY PRODUCTS EXCEEDING 40 MGOE. THE OPPORTUNITY EXISTS TO DESIGN A SYNCHRONOUS MOTOR WITH SUCH PERMANENT MAGNET MATERIALS. SINCE THE WEIGHT OF A MOTOR IS INVERSELY PROPORTIONAL TO THE ENERGY PRODUCT OF THE MAGNET, IT IS CLEAR THAT MOTORS DESIGNED FROM SUCH HIGH ENERGY PERMANENT MAGNETS ARE EXPECTED TO BE SMALLER IN SIZE AND TO POSSESS HIGH TORQUE. SUCH MOTORS ARE USEFUL FOR SEVERAL SPACE APPLICATIONS, SUCH AS IN OPERATING BEAM CONTROL EQUIPMENT, TRACKING AND POINTING WEAPONS, POSITIONING MIRRORS AND POWER GENERATION. THE MOST POPULAR OF THESE PERMANENT MAGNETS MADE OF IRON-NEODYMIUM-BORON RECENTLY HAS BEEN SHOWN TO BE LESS USEFUL FOR SPACE APPLICATIONS DUE TO ITS SUSCEPTIBILITY TO RADIATION DAMAGE AS WELL AS ITS ANOMALOUS BEHAVIOR AT LOW TEMPERATURES. THE POTENTIAL IS BEING EXAMINED OF IRON-COBALT-PRASEODYMIUM-BORON MAGNETS FOR MOTOR DESIGN. THIS MATERIAL POSSESS MAGNETIC PROPERTIES SUPERIOR TO IRON-NEODYMIUM-BORON ALLOYS IN THAT IT DOES NOT EXHIBIT ANY ANOMALY AT LOW TEMPERATURES.

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THESE MAGNETS ARE BEING FABRICATED WITH THEIR SURFACE PASSIVATED WITH A LAYER OF BORON NITRIDE TO REDUCE POTENTIAL CHEMICAL CORROSION AND INCREASE WEAR LIFE. A COMPACT, HIGH TORQUE MOTOR WITH SUCH A MAGNET IS BEING DESIGNED.

ADVANCED MATERIALS TESTING CO  
PO BOX 50726  
PHOENIX, AZ 85076  
CONTRACT NUMBER:  
LONNIE J LUCAS  
TITLE:  
LASER INTERFEROMETRIC STRAIN GAGE FOR HIGH TEMPERATURE  
MATERIALS TESTING  
TOPIC# 13                      OFFICE:

A LASER-BASED INSTRUMENT IS BEING DEVELOPED FOR MEASURING STRAIN AT TEMPERATURES UP TO 4,000F ON CERAMIC AND CARBON COMPOSITE MATERIALS. THE METHOD RELIES ON REFLECTIVE INTERFERENCE OF LASER LIGHT FROM PYRAMID SHAPED INDENTATIONS OR PROTRUSIONS ON THE SPECIMEN SURFACE. METHODS ARE BEING DEVELOPED FOR MAINTAINING THE REFLECTIVITY OF THE SPECIMEN SURFACE OVER THE ACTIVE GAGE LENGTH. BOTH CONVENTIONAL AND NEW IDEAS ARE BEING USED TO INSURE A HIGH PROBABILITY OF SUCCESS. CONVENTIONAL APPROACHES INCLUDE INDENTATION OF THE CERAMIC SURFACE OXIDE LAYER, AND INDENTATION OF SMALL REFRACTORY TABS WHICH ARE BONDED TO THE SAMPLE. A MORE AGGRESSIVE, INNOVATIVE APPROACH IS USING CHEMICAL VAPOR DEPOSITION TO FORM PYRAMID SHAPED CERAMIC CRYSTALS ON THE SPECIMEN SURFACE FROM WHICH LASER LIGHT CAN BE REFLECTED. LATER EFFORTS WOULD BE DIRECTED TOWARDS IMPROVED ELECTRO-OPTICAL PROCESSING OF INTERFERENCE PATTERNS AND DEVELOPMENT OF A COMMERCIALY AVAILABLE GAGE. THE ABILITY TO MEASURE DYNAMIC STRAINS AT TEMPERATURES UP TO 4,000F WOULD PROVIDE A VALUABLE TOOL FOR UNDERSTANDING FAILURE MECHANISMS AND DEVELOPING DESIGN STRATEGIES FOR NON-METALLIC MATERIALS. THE ACCURATE DETERMINATION OF PROPERTIES FOR CERAMIC AND CARBON COMPOSITES IS ESSENTIAL FOR MANY ADVANCED DEFENSE APPLICATIONS.

ADVANCED RESEARCH & APPLICATIONS CORP  
425 LAKESIDE DR  
SUNNYVALE, CA 94086  
CONTRACT NUMBER:  
L J PALKUTI  
TITLE:  
IMPROVED HOT-ELECTRON RELIABILITY FOR LARGE-SCALE INTE  
CIRCUITS BY WAFER-LEVEL IRRADIATION TESTING  
TOPIC# 14                      OFFICE:

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A REAL TIME RELIABILITY SCREENING TECHNIQUE IS BEING DEVELOPED FOR HOT-CARRIER DEGRADATION IN SUBMICRON VLSI DEVICES USING WAFER-LEVEL X-RAY IRRADIATION. SUCH A CONCEPT WOULD ALLOW THE PREDICTION OF VLSI LIFETIME BASED ON THE MEASUREMENT OF SUBSTRATE CURRENT AND TOTAL-DOSE INDUCED INTERFACE STATE FORMATION RATHER THAN THE LONG-TERM VOLTAGE STRESSING TESTING TECHNIQUE. BENEFITS OF THIS CONCEPT INCLUDE THE RAPID TURNAROUND DEVICE LIFETIME EVALUATION AT THE WAFER STAGE AS WELL AS A QUANTITATIVE PROCESS MONITORING TOOL FOR THE DEVELOPMENT OF NEW SUBMICRON VLSI CIRCUITS. ACTIVITIES BEING UNDERTAKEN INCLUDE THE DEFINITION AND COMPUTER EXTRACTION OF CRITICAL DEVICE PARAMETERS RELATED TO HOT-CARRIER PREDICTION BY TOTAL-DOSE IRRADIATION; A CORRELATION TEST TO ESTABLISH RADIATION TESTING AS A RELIABLE TOOL FOR THE DEVELOPMENT AND MONITORING OF HOT-CARRIER HARD PROCESSES; AND AN EXPERIMENTAL DEMONSTRATION OF PREDICTION OF HOT-CARRIER LIFETIMES BY TOTAL-DOSE IRRADIATION AND SUBSTRATE CURRENT MEASUREMENTS. A SUCCESSFUL PROJECT WOULD PROVIDE THE BENEFIT OF A COST-EFFECTIVE AND TIME-EFFECTIVE MEANS OF MONITORING THE RELIABILITY OF SUBMICRON VLSI CIRCUITS AS IT RELATES TO HOT-CARRIER DEGRADATION. BY ESTABLISHING A LINK BETWEEN RADIATION HARDNESS AND HOT-CARRIER HARDNESS, TWO DIFFICULT TECHNOLOGY TASKS CAN BE REDUCED TO ONE.

ADVANCED SYSTEM TECHNOLOGIES INC  
12200 E BRIARWOOD AVE - STE 260  
ENGLEWOOD, CO 90112  
CONTRACT NUMBER:  
GEORGE L KRASOVEC  
TITLE:  
PREDICTING SATELLITE-TO-SATELLITE VISIBILITY PERIODS  
TOPIC# 10                      OFFICE:

TECHNIQUES HAVE EXISTED FOR DECADES THAT PREDICT WHEN A SATELLITE IS IN VIEW OF A GROUND STATION OR ANOTHER SATELLITE. HOWEVER, THESE TECHNIQUES HAVE NEVER BEEN TRULY OPTIMIZED IN TERMS OF PERFORMANCE AND RELIABILITY. TWO KEY OBJECTIVES ARE BEING IDENTIFIED THAT MUST BE SATISFIED TO SHOW FEASIBILITY OF AN IMPROVED GENERAL TECHNIQUE APPLICABLE TO ELLIPTICAL ORBITS: THAT THE SIMPLER PROBLEM FOR NEAR-CIRCULAR ORBITS CAN BE IMPROVED BY AN ORDER OF MAGNITUDE IS BEING DEMONSTRATED, AND THAT THE FREQUENCY OF THE GENERAL VISIBILITY FUNCTION IS EITHER GLOBALLY BOUNDED OR LOCALLY PREDICTABLE IS BEING

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PROVEN. THIS INVESTIGATION IS ADDRESSING THESE TECHNICAL OBJECTIVES BY DERIVING AND ANALYZING NOVEL MATHEMATICAL FORMULATIONS OF THE VISIBILITY PROBLEM, AND VERIFYING THEIR PERFORMANCE AND RELIABILITY THROUGH THE DEVELOPMENT AND EXERCISE OF A VISIBILITY TEST BED. BECAUSE THERE EXISTS A NEED FOR FREQUENT PREDICTION OF SATELLITE VISIBILITY PERIODS, A SUBSTANTIAL REDUCTION OF APPROXIMATELY 250 MILLION FLOATING POINT OPERATIONS PER SECOND IS ANTICIPATED IN BATTLE MANAGEMENT PROCESSING ALONE. THIS WILL PERMIT COMPUTERS TO BE SMALLER WHILE ACCOMPLISHING THE SAME TASKS, OR PERMIT THE REALLOCATION OF EXCESS CAPACITY TO OTHER CRITICAL FUNCTIONS.

ADVANCED TECHNOLOGY MATERIALS INC

520-B DANBURY RD

NEW MILFORD, CT 06776

CONTRACT NUMBER:

DR DUNCAN W BROWN

TITLE:

ORGANOMETALLIC VAPOR PHASE EPITAXIAL GROWTH OF InP AND  
USING HYDRIDE SOURCES (ASH3 AND PH3)

TOPIC# 14

OFFICE:

A MAJOR PROBLEM HINDERING DEVELOPMENT OF ORGANOMETALLIC VAPOR PHASE EPITAXIAL (OMVPE) TECHNIQUES FOR GROWING III/V SEMICONDUCTORS IS THE USE OF THE GROUP V HYDRIDE SOURCES, ARSINE AND PHOSPHINE. USE OF THESE HIGHLY TOXIC, FLAMMABLE MATERIALS CONTAINED UNDER HIGH PRESSURE IN STEEL CYLINDERS REQUIRES INSTALLATION OF EXPENSIVE SAFETY EQUIPMENT AND IN SOME LOCATIONS HAS PRECLUDED APPLICATION OF OMVPE TECHNIQUES. THE GROUP V HYDRIDES ARE PROVEN SOURCES OF WATER AND OXYGEN CONTAMINATION. THEIR HIGH PYROLYSIS TEMPERATURES CAUSE PROBLEMS SUCH AS INABILITY TO CONTROL THE AS/P RATIO IN ALLOYS CONTAINING BOTH ELEMENTS. SAFER GROUP V LIQUID SOURCE REAGENTS ARE BEING IDENTIFIED AND THESE NEW SOURCES USED TO IMPROVE THE OMVPE GROWTH PROCESS. SUCCESSFUL RESULTS OF THIS STUDY WOULD HAVE BROAD APPLICATION IN THE PREPARATION OF COMPOUND SEMICONDUCTOR DEVICES.

AERODYNE PRODUCTS CORP

76 TREBLE COVE RD

NORTH BILLERICA, MA 01862

CONTRACT NUMBER:

KURT D ANNEN

TITLE:

HIGH TEMPERATURE THERMAL STORAGE CONCEPTS FOR CONTINUOUS  
SOLAR SPACE POWER SYSTEM OPERATION

TOPIC# 5

OFFICE:

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THERMAL ENERGY STORAGE FOR SOLAR SPACE POWER SYSTEMS IS AMONG THE MOST ATTRACTIVE FORMS OF ENERGY STORAGE BECAUSE OF HIGH ENERGY DENSITIES ATTAINABLE WITH HIGH LATENT HEAT MATERIALS. HOWEVER, MATERIALS HAVING THE HIGHEST LATENT HEAT, SUCH AS SI AND SI-B EUTECTIC, ARE ALSO DIFFICULT TO CONTAIN DUE TO THE REACTIVE NATURE OF THEIR LIQUID PHASES. USE OF THESE ADVANCED THERMAL STORAGE MATERIALS, THEREFORE, REQUIRES INNOVATIVE CONCEPTS TO OVERCOME THIS PROBLEM. THERMAL STORAGE APPROACHES ARE BEING INVESTIGATED BASED ON THE CONCEPT OF CONTROLLING THE LIQUID-SOLID INTERFACE OF THE THERMAL STORAGE MEDIUM SO THAT THE LIQUID PHASE IS NEVER IN CONTACT WITH THE HEAT TRANSFER PASSAGES. TWO-DIMENSIONAL, TIME-DEPENDENT HEAT TRANSFER AND FLUID DYNAMICS MODELS ARE BEING USED TO EVALUTE THE THERMAL PERFORMANCE OF SOLAR RECEIVER/THERMAL STORAGE CONCEPTS AND THE STABILITY AND CONTROLLABILITY OF THE LIQUID-SOLID INTERFACE. THE DESIGN INVESTIGATION OF THE CONCEPTS IS ALSO ADDRESSING ISSUES OF CONTROL OF THE LIQUID FREE SURFACE, THERMAL EXPANSION DIFFERENCES BETWEEN THE THERMAL STORAGE MATERIAL AND THE HEAT TRANSFER PASSAGE MATERIAL, AND INTERACTION BETWEEN THE SOLAR RECEIVER/THERMAL STORAGE UNIT AND THE BRAYTON CYCLE UNIT. A HIGH PERFORMANCE, LOW WEIGHT, HIGH RELIABILITY THERMAL STORAGE SYSTEM FOR SPACE POWER WOULD ENHANCE THE ECONOMIC VIABILITY OF COMMERCIAL USES OF THE SPACE STATION.

AERODYNE RESEARCH INC

45 MANNING RD

BILLERICA, MA 01821

CONTRACT NUMBER:

DR ROGER S PUTNAM

TITLE:

PULSE RECORDED HOLOGRAPHIC FILTERS FOR PRECISE SENSOR

TOPIC# 8

OFFICE:

PROTECTION OF OPTICAL SENSORS IS NECESSARY FROM COUNTERMEASURES SUCH AS DAMAGING HIGH PULSE ENERGY OPTICAL INPUT AND LOW POWER BUT CONTINUOUS OPTICAL NOISE. POWERFUL LASER SCATTER FROM UNKNOWN PARTICULATE MATTER AND DEBRIS ALSO CAN ENDANGER THESE SENSORS AS A RESULT OF USING THE SYSTEM'S OWN ON-BOARD BEAM WEAPONS. USE OF OPTICAL NOTCH FILTERS AT LIKELY WAVELENGTHS IS ONE PROTECTION TECHNIQUE. HOLOGRAPHIC FILTERS CAN PROTECT THE SENSORS AT VARIOUS WAVELENGTHS AND IN DIFFERENT CHOSEN DIRECTIONS SIMULTANEOUSLY.

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OBTAINING THE EXTREME REJECTION DESIRED AND THE PROPER BANDPASS BEHAVIOR DEMANDS THE USE OF THICK HOLOGRAMS. THESE THICK HOLOGRAMS, HOWEVER, SUFFER FROM A NONUNIFORMITY THAT RESULTS FROM FEEDBACK INFLUENCE OF THE PARTLY EXPOSED HOLOGRAM ON THE RECORDING LASER BEAMS. A NEW PULSED EXPOSURE TECHNIQUE FOR PREPARING HOLOGRAPHIC FILTERS WITH GREATER UNIFORMITY AND CONTROL THROUGHOUT THEIR VOLUME IS BEING INVESTIGATED THAT WOULD PRODUCE A NARROWER OPTICAL NOTCH FILTER WITH GREATER ATTENUATION AND A MORE EFFICIENT USE OF THE PHOTSENSITIVE MEDIUM. THE SUCCESSFUL DEMONSTRATION OF THIS TECHNIQUE WILL ALLOW HOLOGRAPHIC ELEMENTS INCLUDING BOTH FILTERS AND LENSES TO BE SYNTHESIZED WITH MUCH GREATER CONTROL. IMPROVED SENSOR PROTECTION WOULD RESULT INCLUDING SHARP LASER LINE REJECTION WITH REDUCED PASSBAND ATTENUATION AND SCATTER IN THESE COMPLEX HOLOGRAPHIC LENSES.

ALABAMA CRYOGENIC ENGINEERING INC  
PO BOX 2451  
HUNTSVILLE, AL 35804  
CONTRACT NUMBER:  
DR JOHN B HENDRICKS  
TITLE:  
CRYOCOOLER FOR SPACE-BASED LONG WAVELENGTH INFRARED SE  
TOPIC# 3                      OFFICE:

LONG WAVELENGTH INFRARED (LWIR) SENSORS ARE BECOMING INCREASINGLY IMPORTANT. FOR MISSILE TRACKING, TARGETS ARE INHERENTLY "COLD" AND THUS REQUIRE LONG WAVELENGTH DETECTOR SYSTEMS. THERE IS A NEED TO DEVELOP A CRYOCOOLER SYSTEM THAT CAN OPERATE UNATTENDED FOR LONG PERIODS IN SPACE BETWEEN 20K AND 4K, THUS OPENING THE POSSIBILITY OF OPERATIVE LWIR SENSORS IN THE 10 TO 140 MICROMETER RANGE. MATERIALS SUCH AS HgCdTe CAN OPERATE OUT TO WAVELENGTHS OF 10 MICROMETERS OPERATING AT 80K. DOPED Ge MATERIALS CAN OPERATE OVER THE 10-100 UM BAND, BUT MUST BE COOLED TO FROM 4K TO 30K, DEPENDING ON THE MATERIAL AND WAVELENGTH. THIS ADDITIONAL COOLING IS A SEVERE DRAWBACK AS THE CURRENT COOLING TECHNOLOGY DOES NOT EXTEND BELOW 80K. TO EXTEND BEYOND THIS WAVELENGTH, COLDER OPERATING TEMPERATURES ARE REQUIRED. THIS INVESTIGATION COVERS A CRYOCOOLER STAGE THAT CAN OPERATE OUT TO 4K, THEREBY MAKING AVAILABLE MANY USEFUL INFRARED DETECTOR MATERIALS. IN ADDITION TO BEING SPACE COMPATIBLE AND CAPABLE OF LONG LIFETIME OPERATION WITH NO MAINTENANCE, THE REFRIGERATION APPROACH IN SUCH A

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CRYOCOOLER DESIGN REQUIRES A HEAT EXCHANGER WITH VERY HIGH EFFECTIVENESS. THE FEASIBILITY OF USING A MINIATURE PARALLEL PLATE HEAT EXCHANGER IS BEING EXAMINED. DESIGN PARAMETERS AND PLATE FABRICATION TECHNIQUES ARE BEING DEVELOPED.

ALABAMA CRYOGENIC ENGINEERING INC  
PO BOX 2451  
HUNTSVILLE, AL 35804  
CONTRACT NUMBER:  
DR JOHN B HENDRICKS  
TITLE:  
PHASE SEPARATOR FOR SPACE CRYOGEN STORAGE SYSTEMS  
TOPIC# 6                      OFFICE:

ALL THE CURRENT APPROACHES TO THE VENTING PROBLEM IN SPACE CRYOGENIC STORAGE SYSTEMS HAVE MAJOR PROBLEMS SINCE STORAGE DEWARs FOR CRYOGENS REQUIRE A PHASE SEPARATOR WHEN OPERATED IN ZERO GRAVITY. A TECHNIQUE IS BEING INVESTIGATED FOR PROVIDING THIS PHASE SEPARATION. THIS APPROACH INVOLVES THE DEVELOPMENT OF A PHASE SEPARATOR, CALLED A TRAPPING PLUG, THAT OPERATES USING SURFACE TENSION. A PASSIVE SYSTEM WITH NO MOVING PARTS AT CRYOGENIC TEMPERATURES, THE TRAPPING PLUG'S CONTROLLING ELEMENT, A VALVE, OPERATES AT THE WARM END OF THE DEWAR VENT LINE. SUCH AN APPROACH OFFERS SIMPLIFIED, HIGH RELIABILITY CONSTRUCTION WHEN COMPARED TO THE CURRENT TECHNOLOGY. A PARAMETRIC STUDY IS BEING MADE OF THE EFFECT OF PORE DIAMETER AND PORE LENGTH (PLATE THICKNESS). THE EFFECTS ARE BEING STUDIED OF PLATE THERMAL CONDUCTIVITY AND OF THE OPERATION OF THE TRAPPING PLUG SPREADING RESISTANCE AT THE FLUID METAL INTERFACE. THE PROCESS IS BEING DEFINED FOR THE SCALED-UP CONSTRUCTION OF A LARGE AREA TRAPPING PLUG FOR PRACTICAL SPACE DEWAR SYSTEMS. THE OPERATION OF THE TRAPPING PLUG IS BEING COMPARED TO THE OPERATION OF THE CONVENTIONAL THERMODYNAMIC VENT SYSTEM. THE EFFECT OF SPLIT FLOW ON THE OVERALL EFFICIENCY OF DUAL CRYOGEN STORAGE SYSTEMS IS BEING STUDIED. A TEST SYSTEM IS BEING DESIGNED FOR DEMONSTRATING THE TRAPPING PLUG.

AMERICAN MATRIX INC  
PO BOX 23556  
KNOXVILLE, TN 37933  
CONTRACT NUMBER:  
DR SAMUEL C WEAVER  
TITLE:  
ELECTRONIC GRADE SILICON CARBIDE SEMICONDUCTOR MATERIAL  
TOPIC# 14                      OFFICE:



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A PROCESS FOR THE MANUFACTURE OF HIGH PURITY SILICON CARBIDE PLATELETS (SMALL WAFERS) PREVIOUSLY HAS BEEN DEMONSTRATED THAT HAS THE CAPABILITY TO PRODUCE PLATELETS WITH AVERAGE DIAMETERS GREATER THAN ONE CENTIMETER. THE PLATELETS PRODUCED BY THIS PROCESS HAVE SHOWN THE POTENTIAL FOR HIGH ELECTRON MOBILITY, CHEMICAL AND PHYSICAL STABILITY UNDER RADIATION LEVELS PROJECTED TO BE IN EXCESS OF TEN YEARS IN A DEEP SPACE ENVIRONMENT AND ELECTRICAL RESISTIVITY VALUES IN EXCESS OF 50 OHMS-CM. CRITICAL LIMITS FOR THE PROCESS PARAMETERS ARE BEING DEFINED AND ESTABLISHED THAT CONTROL THE SIZE OF THE PLATELETS. BASELINE CHEMICAL AND PHYSICAL PROPERTIES ARE BEING ESTABLISHED USING SUCH ANALYTICAL TECHNIQUES AS HALL MEASUREMENTS, SHEET RESISTANCE, AND SCANNING ELECTRON MICROSCOPY. BY APPLICATION OF ESTABLISHED DESIGN OF EXPERIENCE TECHNIQUES, THE TEST SPECIMENS ARE BEING SUBJECTED TO A SERIES OF DESIGN EXPERIMENTS INVOLVING THE APPLICATION OF HEAT IN COMBINATION WITH VARIOUS ATMOSPHERES TO OPTIMIZE THE POTENTIAL ELECTRONIC PROPERTIES OF THE PLATELETS. A MANUFACTURING PROCESS WHICH WOULD CONSISTENTLY YIELD INEXPENSIVE, HIGH VOLUME, HIGH PURITY, HIGH QUALITY SILICON CARBIDE PLATELETS SUITABLE FOR USE IN ELECTRONIC APPLICATIONS INCLUDING SEMICONDUCTOR APPLICATIONS.

AMORPHOUS MATERIALS & TECHNOLOGIES INC  
10005 MUIRLANDS - STE M  
IRVINE, CA 92718  
CONTRACT NUMBER:  
DAVID M SCRUGGS  
TITLE:  
AMORPHOUS METALLIC REFRACTORY ALLOY COATING FOR STRUCT  
TRIBOLOGICAL USE  
TOPIC# 13                      OFFICE:

COMPOSITES OF VARIOUS TYPES ARE EXCELLENT CANDIDATES FOR WEIGHT EFFICIENT SPACE STRUCTURES. THE LEADING CANDIDATES ARE SENSITIVE TO SURFACE DAMAGE AND OXIDATION. PROPERTIES OF THE COMPOSITE SURFACES ARE NOT WELL SUITED FOR EXPOSURE TO SLIDING MOTION AND TO WEAR. THE FEASIBILITY IS BEING ASSESSED OF PROVIDING SURFACE PROTECTION AND A TRIBOLOGICALLY EFFECTIVE SURFACE FOR SPACE STRUCTURAL MATERIALS VIA THE APPLICATION OF AN AMORPHOUS ALLOY ELECTROPLATE BASED ON TUNGSTEN ALLOYED TOGETHER WITH NICKEL AND/OR COBALT. IT IS ALREADY KNOWN THAT

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THIS ELECTROPLATE WILL ADHERE TO A VARIETY OF METALS AND TO GRAPHITE. THE COMPATIBILITY WITH CANDIDATE SURFACES REPRESENTING A RANGE OF POSSIBLE STRUCTURAL MATERIALS IS BEING EXAMINED OVER A RANGE OF TEMPERATURES AND COATING THICKNESSES. THE PHYSICAL PROPERTIES OF THE MOST COMPATIBLE COATING ARE BEING DETERMINED, AND DESIGN INFORMATION PROVIDED TO SUPPORT FURTHER INVESTIGATION. TEST SPECIMENS ARE BEING PROVIDED TO ENABLE A PRIMARY ASSESSMENT OF TRIBOLOGICAL BEHAVIOR. SUCCESSFUL DEVELOPMENT WOULD PROVIDE A CRACK FREE, HOMOGENEOUS AMORPHOUS METAL COATING OF VERY HARD HARDNESS AND MODULUS THAT CAN EFFECTIVELY PROTECT AGAINST IMPACT AND ABRASION. COMMERCIAL APPLICATIONS COULD INCLUDE PROTECTION OF LIGHTWEIGHT STRUCTURES IN AIRCRAFT AND VEHICLES, LINEAR AND ROTATING BEARINGS AND ACTUATORS.

ANTECH SERVICES INC  
9937 JEFFERSON BLVD  
CULVER CITY, CA 90232  
CONTRACT NUMBER:  
DR KARL BERNSTEIN  
TITLE:  
LASER ATTACK SURVIVABILITY  
TOPIC# 8                      OFFICE:

VISIBLE AND INFRARED OPTICAL SYSTEMS ARE WIDELY USED FOR SURVEILLANCE AND MAY BE USED FOR DIRECTING STRATEGIC DEFENSE WEAPONS. THESE SYSTEMS ARE POTENTIALLY VULNERABLE TO ATTACK BY LASERS OF MODERATE SIZE BASED ON THE GROUND, IN HIGH ALTITUDE AIRCRAFT, OR IN SPACE. PASSIVE HARDENING TECHNIQUES MAY SATISFY SOME OF THE REQUIREMENTS BUT NOT ALL. FOR TRUE MITIGATION OF THE LASER WEAPON RISK AGAINST ELECTRO-OPTICAL SYSTEMS, ACTIVE DEFENSE MEASURES ALSO WILL BE REQUIRED STARTING WITH DETECTION OF THE CONDITIONS UNDER WHICH IMMINENT ATTACK IS REASONABLY PROBABLE. BOTH THE ALERT AND SHIELD IMPLEMENTATION TECHNIQUES WOULD HAVE TO BE COMPATIBLE WITH THE ANTICIPATED ALERT TIME AVAILABLE. THE FEASIBILITY IS BEING EXPLORED OF DESIGNING, MANUFACTURING, AND TESTING LASER ATTACK WARNING AND PROTECTION CONCEPTS UNDER VARYING CONDITIONS FOR RAPID DETECTION OF AN IMMINENT THREAT AND FOR RAPID DEPLOYMENT OF AT LEAST ONE BARRIER TO LASER ATTACK. THE CONCEPTS ARE BEING EXAMINED FOR APPLICABILITY TO SATELLITE DEFENSE, WITH SPECIAL REGARD TO APPROXIMATE SIZE, WEIGHT, AND POWER REQUIREMENTS, AND OTHER CONSIDERATIONS.

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ANTROPIX CORP  
351 TEALWOOD DR  
HOUSTON, TX 77024  
CONTRACT NUMBER:  
DR MICHAEL BERRY

TITLE:

LASER PROBE ABSORPTION SPECTROSCOPY SYSTEM FOR VAPOR A  
MEASUREMENTS

TOPIC# 9

OFFICE:

RECENT STUDIES OF LASER/MATERIALS INTERACTIONS HAVE IDENTIFIED SEVERAL CRITICAL UNCERTAINTIES IN THE MECHANISMS RESPONSIBLE FOR PRODUCING A GIVEN LEVEL OF HARDNESS DURING IRRADIATION OF SPACECRAFT MATERIALS BY BOTH CONTINUOUS WAVE AND REPETITIVE LASERS. SPATIALLY AND TEMPORARILY RESOLVED VAPOR AND PLASMA MEASUREMENTS ARE BEING OBTAINED IN LASER INDUCED PLUMES USING A LASER PROBE. COMPUTER CONTROLLED TUNABLE LASER SOURCES ARE BEING EXTENDED TO SHORTER WAVELENGTH OPERATION AND FAST MULTICHANNEL ARRAY DETECTORS WITH RAPID SIGNAL ACQUISITION AND PROCESSING TECHNIQUES ARE BEING USED TO PROVIDE THE TEMPORAL AND SPATIAL RESOLUTION REQUIRED FOR SINGLE PULSE AND REPETITIVE PULSE LASER IRRADIATION CONDITIONS. PLUME SPECTROSCOPY MEASUREMENTS ARE BEING PERFORMED ON BASELINE AND MODEL MATERIALS TO ESTABLISH THE ABUNDANCES, ENERGY CONTENTS, AND TRANSIENT OPTICAL PROPERTIES OF VAPOR AND PLASMA SPECIES AS FUNCTIONS OF LASER PARAMETERS AND ENVIRONMENTAL CONDITIONS. THIS PLUME DIAGNOSTIC INFORMATION IS BEING RELATED TO MECHANISTIC MODELS OF LASER/MATERIALS INTERACTIONS WITH PARTICULAR EMPHASIS ON LETHALITY AND TARGET HARDENING ISSUES. THE SAME INSTRUMENTATION ALSO IS BEING APPLIED TO OXIDATION PRODUCT MEASUREMENTS IN ORDER TO PROVIDE FUNDAMENTAL QUANTITATIVE INFORMATION ON THE KINETICS AND MECHANISMS OF OXIDATION PROTECTION SYSTEMS.

APA OPTICS INC  
2950 NE - 84TH LN  
BLAINE, MN 55432  
CONTRACT NUMBER:  
DR M A KHAN

TITLE:

ATOMIC LAYER CHEMICAL VAPOR DEPOSITION OF ALGAN FOR SO  
ULTRAVIOLET DETECTORS

TOPIC# 14

OFFICE:

SUBMITTED BY  
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USE OF ATOMIC LAYER EPITAXY IS BEING INVESTIGATED FOR GROWING SINGLE CRYSTAL ALGAN LAYERS. THE FORMATION OF NITROGEN VACANCIES IS EXPECTED TO BE SUPPRESSED BY THE UNIQUE ATOMIC LAYER DEPOSITIONS AND THE EXCITATION OF  $NH_3$  GAS BY A LASER SOURCE. THIS SHOULD RESULT IN HIGH QUALITY LARGE AREA SINGLE CRYSTAL LAYERS OF ALGAN WHICH COULD BE USED TO MAKE SOLAR BLIND ULTRA-VIOLET (UV) SENSORS. THESE THIN EPI-LAYERS COULD ALSO BE USED AS SHARP CUT-OFF RUGGED SOLAR BLIND PHOTOCATHODES. ULTRA-VIOLET SENSORS MADE FROM THE MATERIAL ARE USABLE ALSO IN FIRE PROTECTION AND BOILER SAFETY SYSTEMS. ULTRA-VIOLET SENSING IS THE BASIS FOR SEVERAL DEFENSE AND COMMERCIAL APPLICATIONS. THESE INCLUDE FLAME SENSING, MISSILE PLUME DETECTION AND UV SPECTROSCOPY. FLAME SENSING IS A KEY SAFETY REQUIREMENT FOR ALL COMMERCIAL BOILER SYSTEMS AND INSTALLATIONS DEALING WITH OIL AND GAS PRODUCTION.

APOGEE RESEARCH CORP  
76 SANTA ANA AVE  
LONG BEACH, CA 90803  
CONTRACT NUMBER:  
DR RALPH S COOPER  
TITLE:  
SPACE POWER ADVISORY SYSTEM FOR SELECTION EVALUATION A  
CONCEPTUAL DESIGN  
TOPIC# 4                      OFFICE:

STRATEGIC DEFENSE SPACECRAFT AND WEAPONS REQUIRE POWER SUPPLIES IN NEW REGIMES OF POWER AND DURATION WITH REQUIREMENTS (E.G., SURVIVABILITY) DIFFERENT FROM PAST SYSTEMS. A COMPUTER BASED SYSTEM IS BEING DEVELOPED TO ASSIST PLANNERS AND DESIGNERS IN THE SELECTION, EVALUATION AND CONCEPTUAL DESIGN OF SUCH POWER SUPPLIES. IT USES THE EMERGING TECHNIQUES OF EXPERT SYSTEMS TO HANDLE THE POWER SYSTEM SYNTHESIS AND QUALITATIVE ISSUES SUCH AS SURVIVABILITY, MAINTENANCE, AND RELIABILITY. A DEMONSTRATION SYSTEM IS BEING GENERATED FOR ONE POWER SUPPLY TYPE. THIS PROGRAM IS APPLYING EXPERT SYSTEM TECHNIQUES TOGETHER WITH CONVENTIONAL ALGORITHMS TO ACHIEVE EARLY OPERATIONAL CAPABILITY. MODELS, SCALING LAWS AND HEURISTIC RULES ARE BEING DEVELOPED AND A DATA BASE OF TECHNOLOGY PARAMETERS COLLECTED. THIS PROJECT, IF SUCCESSFUL, WOULD PROVIDE A SET OF COMPUTER BASED TOOLS TO ASSIST DECISION MAKERS AND DESIGNERS IN ORGANIZING THE LARGE AND COMPLEX KNOWLEDGE BASE AND IN FINDING SUITABLE POWER SYSTEMS. IT

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WOULD YIELD A CONSISTENT, COMPREHENSIVE, TRANSPORTABLE PROGRAM FOR POWER SYSTEM ANALYSIS THAT WOULD BE OF VALUE TO FEDERAL AND INDUSTRIAL ORGANIZATIONS.

APPLIED RESEARCH ASSOCS INC  
6404 FALLS OF NEUSE RD - STE 200  
RALEIGH, NC 27615  
CONTRACT NUMBER:  
WILLIAM L DUNN  
TITLE:  
MULTIDIMENSIONAL ANALYSIS TECHNIQUES FOR DIRECTED ENER  
TOPIC# 1 OFFICE:

MANY DEFENSE SITUATIONS INVOLVING LASER AND PARTICLE BEAMS REQUIRE SOLUTIONS TO THE THREE DIMENSIONAL BOLTZMANN EQUATION FOR THE RADIATION DISTRIBUTION INSIDE A MEDIUM SUBJECT TO A DIRECTED ENERGY BEAM AT ARBITRARY INCIDENCE. PROPERLY CONSTRUCTED SEMIANALYTIC SOLUTIONS WOULD BE MORE COMPUTATIONALLY EFFICIENT THAN STRICTLY NUMERICAL SOLUTIONS, PROVIDE INSIGHT INTO THE PHYSICS OF BEAM INTERACTIONS, PRODUCE SOLUTIONS THAT ARE CONTINUOUS FUNCTIONS OF AT LEAST SOME OF THE PHASE-SPACE VARIABLES AND OFFER A BENCHMARK FOR OTHER SOLUTION TECHNIQUES. THE APPROACH BEING UNDERTAKEN IS BASED ON THE FACILE (OR FN) METHOD, WHICH HAS BEEN SHOWN TO BE EFFICIENT FOR A VARIETY OF RADIATION TRANSPORT PROBLEMS IN ONE DIMENSION, AND HAS BEEN USED TO SOLVE A TWO-DIMENSIONAL PROBLEM DETERMINING THE EXIT NORMAL FLUX FROM A MEDIUM IRRADIATED BY A BEAM AT NORMAL INCIDENCE. INVESTIGATORS RECENTLY HAVE BEEN ABLE TO REMOVE THE SINGULAR COMPONENTS OF THE SOLUTION, THEREBY MAKING EVALUATION OF THE REMAINING COMPONENT NUMERICALLY FEASIBLE. THE FN METHOD IS BEING USED BECAUSE OF ITS CONSIDERABLE COMPUTATIONAL MERITS, WHICH INCLUDE SIMPLICITY, EFFICIENCY, ACCURACY AND ROBUSTNESS. IF SUCCESSFUL, THE RESEARCH WOULD HAVE IMPLICATIONS FOR A VARIETY OF COMMERCIAL DIRECTED ENERGY APPLICATIONS INCLUDING THE PRODUCTION OF TRANSIENTS IN MICROELECTRONIC CIRCUITS CAUSED BY EXTERNAL RADIATION.

APPLIED RESEARCH CORP  
8201 CORPORATE DR - STE 920  
LANDOVER, MD 20785  
CONTRACT NUMBER:  
DR A S ENDAL  
TITLE:  
RADIATION HARD SENSORS FOR SURVEILLANCE  
TOPIC# 8 OFFICE:

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HARDENING AND SURVIVABILITY OF SENSORS IN A SPACE-BASED MISSILE DEFENSE SYSTEM WILL BE A KEY ISSUE IN THE EFFECTIVENESS OF SUCH A SYSTEM, PARTICULARLY AGAINST X-RAY LASERS AND BRIGHT SHORT WAVELENGTH GROUND-BASED LASERS. A NEW CLASS OF RADIATION-HARD, SOLID-STATE PARTICLE/RADIATION DETECTORS IS BEING DEVELOPED WITH SUPERIOR ENERGY RESOLUTION, EXCELLENT SPATIAL RESOLUTION AND LARGE SURFACE AREA. USING CRYOGENIC TECHNIQUES, ORDER-OF-MAGNITUDE IMPROVEMENTS IN THE MAXIMUM TOLERABLE RADIATION DOSE ARE EXPECTED; A RADIATION DOSE OF 100 MEGARAD SHOULD NOT DESTROY THE DETECTOR CAPABILITIES. THE DETECTOR IS EXPECTED TO PROVIDE EXCELLENT PROTECTION AGAINST ELECTROMAGNETIC AND RADIATION EFFECTS WHICH MIGHT BE ENCOUNTERED IN A SPACE-BASED MISSILE DEFENSE SYSTEM. THE DETECTOR WOULD CONSIST OF A LARGE ARRAY OF SUPERCONDUCTING SENSORS AND COULD PROVIDE SPATIAL RESOLUTION OF A FEW MICRONS WITH A REASONABLE NUMBER OF READ-OUT CHANNELS. SUBNANOSECOND TIME RESOLUTION IS ANTICIPATED IN A PHOTON-COUNTING MODE. THE DETECTOR ALSO COULD BE ENGINEERED AS A SENSOR FOR X-RAY, GAMMA AND NEUTRON RADIATION. IN THE CURRENT EFFORT, AN ARRAY OF REFRACTORY METAL MICRON-SIZE STRUCTURES ARE BEING PRODUCED AND CHARACTERIZED. TESTS ARE BEING CONDUCTED OF RADIATION DAMAGE OF TIN-SUPERHEATED SUPERCONDUCTING DETECTORS AND REFRACTORY METAL SUPERHEATED SUPERCONDUCTING AREA DETECTORS.

APPLIED RESEARCH INC  
5025 BRADFORD BLVD  
HUNTSVILLE, AL 35814  
CONTRACT NUMBER:  
LARRY Z KENNEDY  
TITLE:  
MULTIVALUED LOGIC ALL OPTICAL DIGITAL COMPUTER  
TOPIC# 11                      OFFICE:

CURRENT ELECTRONIC DIGITAL COMPUTERS CANNOT OPERATE AT RATES NECESSARY TO ACCOMPLISH REAL-TIME IMAGE PROCESSING, ARTIFICIAL INTELLIGENCE, RADAR PROCESSING, SIMULATED NEURAL NETWORKS, AND OTHER COMPUTATION INTENSIVE PROBLEMS FOR STRATEGIC DEFENSE APPLICATIONS. ALL-OPTICAL DIGITAL COMPUTING (AODC) HAS THE POTENTIAL TO BECOME THE ULTIMATE COMPUTING TECHNOLOGY FOR SPEED AND THROUGHPUT IN SUCH APPLICATIONS. AN OPTICALLY ADDRESSED BISTABLE SWITCHING DEVICE IS AN ELEMENT OF A MULTIVALUED LOGIC (MVL) AODC. BESIDES THE ADVANTAGES OF LIGHT AS THE

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SIGNAL MEDIUM, THE TABLE LAYOUT OF THE DEVICE IS UTILIZABLE AS AN MVL OPERATION TABLE. WHILE IT IS KNOWN THAT MVL, AS OPPOSED TO BINARY LOGIC, ALLOWS ENHANCED LOGIC DENSITY AND DECREASED INTERCONNECT REQUIREMENTS FOR ELECTRONIC COMPUTERS, ELECTRONIC COMPUTING IS MOSTLY BINARY BECAUSE THERE ARE NO TRUE ELECTRONIC MVL DEVICES. AN AODC DEVICE IS A TRUE MVL DEVICE. THE FEASIBILITY AND UTILITY OF A MVL AODC CONCEPT ARE BEING EVALUATED. VARIOUS MVL ORDERS ARE BEING EVALUATED FOR THE SPECIAL ADVANTAGES OF HIGH LOGIC DENSITY AND INFORMATION CONTENT PER INTERCONNECT AND RELATIVE SPEED. FREE SPACE INTERCONNECT METHODS ARE BEING EVALUATED BY DIGITAL SIMULATION OF THE REFLECTIVE DIFFRACTIVE OPTICAL ELEMENT TO DETERMINE SIZE PARAMETERS. THE CONCEPTUAL DESIGN FOR A PROTOTYPE MVL AODC DEMONSTRATION MODULE IS BEING DEVELOPED INCLUDING CONSIDERATION OF INPUT/OUTPUT AND DEVICE CONTROL.

APPLIED SCIENCES INC  
PO BOX 186 - 800 LIVERMORE ST  
YELLOW SPRINGS, OH 45387  
CONTRACT NUMBER:  
MAX L LAKE  
TITLE:  
HIGH TEMPERATURE LIGHTWEIGHT COMPOSITES FOR SPACE NUCL  
STRUCTURES  
TOPIC# 4                      OFFICE:

SPACE POWER SYSTEMS REQUIRE CONSTRUCTION MATERIALS WHICH HAVE LOW DENSITY, HIGH THERMAL CONDUCTIVITY, AND HIGH ELECTRICAL CONDUCTIVITY AT ELEVATED TEMPERATURES. CARBON COMPOSITES ARE GOOD CANDIDATES FOR THESE MATERIALS. VAPOR GROWN GRAPHITE FIBERS HAVE BEEN SHOWN TO HAVE CHARACTERISTICS OF THERMAL CONDUCTIVITY AND STRENGTH WHICH COMPARE WITH PAN AND PITCH BASED GRAPHITE FIBERS, BUT WHICH HAVE AN ELECTRICAL RESISTIVITY THAT COMPETES WITH SINGLE CRYSTAL GRAPHITE. DOPING OF GRAPHITE IS KNOWN TO CHANGE THE DISTRIBUTION OF ELECTRONS BETWEEN ENERGY LEVELS IN CARBON, TO AFFECT THE GRAPHITIZATION PROCESS, AND TO MODIFY THE CHEMICAL STATE OF THE SURFACE OF CARBON PARTICLES. THE GROWTH MECHANISMS OF VAPOR GROWN GRAPHITE FIBERS IS BEING EXPLORED FOR DEVELOPING ARBITRARY LENGTHS OF THIS TYPE OF FIBER. THE LEVEL OF DOPING IS BEING STUDIED THAT RESULTS IN THE OPTIMUM (LOWEST) RESISTIVITY FOR TEMPERATURES ABOVE 2000 C. LOW ELECTRICAL RESISTIVITY

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GRAPHITE WOULD HAVE IDEAL PROPERTIES FOR USE IN SPACE NUCLEAR POWER THERMIONIC CONVERSION. VAPOR GROWN CARBON FIBERS FROM NATURAL GAS COULD LEAD TO DEVELOPMENT OF COMPETITIVE HIGH PERFORMANCE CARBON COMPOSITES WHICH WOULD FIND APPLICATIONS IN SPACECRAFT, AIRCRAFT, SHIPS, AUTOMOBILES, AND WELL-LOGGING EQUIPMENT.

APPLIED SCIENCES INC  
PO BOX 186 - 800 LIVERMORE ST  
YELLOW SPRINGS, OH 45387  
CONTRACT NUMBER:  
MAX L LAKE  
TITLE:  
PROCESSED VAPOR GROWN GRAPHITE FIBERS FOR ELECTROMAGNE  
TOPIC# 2 OFFICE:

REQUIREMENTS FOR RAILGUN ARMATURES DICTATE MATERIALS PROPERTIES VALUES WHICH ARE DIFFICULT TO OBTAIN FROM CONVENTIONAL MATERIALS. THE NEED EXISTS FOR A MATERIAL WHICH HAS LOW DENSITY, HIGH MELTING POINT, HIGH THERMAL CONDUCTIVITY, LOW COEFFICIENT OF THERMAL EXPANSION, HIGH ELECTRICAL CONDUCTIVITY, HIGH VALUES FOR STRENGTH, AND GOOD CHARACTERISTICS OF LUBRICITY. GRAPHITE FIBER GROWN FROM PYROLYSIS OF HYDROCARBON GAS, WHICH IS THEN PROCESSED TO YIELD USEFUL VALUES FOR ELECTRICAL CONDUCTIVITY, IS A MATERIAL HAVING ATTRACTIVE PROPERTIES. DEVELOPMENT OF PROCESSED VAPOR GROWN GRAPHITE FIBERS HAVING THE REQUISITE VALUES OF ELECTRICAL CONDUCTIVITY AND OTHER MATERIALS PROPERTIES IS BEING INVESTIGATED. FEASIBILITY OF DEVELOPING THIS MATERIAL IS BEING DEMONSTRATED AND CRITERIA FOR MANUFACTURING SCALE-UP OF THIS NOVEL MATERIAL WOULD BE EXPLORED IN A LATER PHASE. THIS MATERIAL WILL HAVE APPLICATIONS IN CHOPPED FIBER CARBON COMPOSITES INCLUDING PLASTIC, CERAMIC, CEMENT AND METAL MATRICES, WHEREIN EXTREME VALUES OF MATERIALS PROPERTIES ARE REQUIRED FOR DESIGN OF HIGH PERFORMANCE DEVICES AND SYSTEMS FOR SPACE AND AEROSPACE APPLICATIONS, INDUSTRY, MEDICINE AND SPORTS.

ASTRON RESEARCH & ENGINEERING  
130 KIFER CT  
SUNNYVALE, CA 94086  
CONTRACT NUMBER:  
JOHN H. HUNTINGTON  
TITLE:  
SYSTEM TRADES BETWEEN VELOCITIES AND VEHICLE MASSES FO  
ENERGY WEAPON HYPERVELOCITY  
TOPIC# 2 OFFICE:



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HYPERVELOCITY GUNS CAN PLAY AN IMPORTANT ROLE IN BOTH GROUND-SPACED AND SPACE-BASED BALLISTIC MISSILE DEFENSE. A DETERMINATION MUST BE MADE WHETHER ELECTROMAGNETIC LAUNCHERS (EMLS) ALONE OR COMBINED WITH THERMODYNAMIC GUN INJECTORS AND/OR ROCKET-ASSISTED PROJECTILES WILL PROVE MOST APPROPRIATE. EML SYSTEMS ALSO MUST BE COMPARED AGAINST ROCKETS AND CONCEPTS SUCH AS THE RAM-CANNON AND AIR-AUGMENTED SYSTEMS IN ORDER TO DETERMINE THE BEST APPROACH FOR A PARTICULAR APPLICATION. A SYSTEMS ANALYSIS APPROACH TO THE SELECTION AND OPTIMIZATION OF HYPERVELOCITY LAUNCHERS IS BEING EMPLOYED, WITH EMPHASIS ON THE EML, TO PROVIDE THE STRATEGIC DEFENSE COMMUNITY WITH TECHNICAL GUIDANCE IN THESE ISSUES. THIS METHOD IS BEING DEMONSTRATED UPON A GROUND-BASED SYSTEM WITH SPECIFIC PERFORMANCE OBJECTIVES. IN A LATER PHASE, A MONOGRAPH, TOGETHER WITH MAGNETIC DISKS COULD BE PRODUCED, SO THAT SYSTEMS ANALYSES COULD BE PERFORMED ON DESK-TOP COMPUTERS. THE MONOGRAPH WOULD CONTAIN EQUATIONS PARAMETRICALLY DESCRIBING THE VARIOUS LAUNCHERS, INCLUDING PERFORMANCE, SIZE, WEIGHT AND COST.

ASTRON RESEARCH & ENGINEERING

130 KIFER CT

SUNNYVALE, CA 94086

CONTRACT NUMBER:

CHARLES POWARS

TITLE:

HYPERVELOCITY ENDOATMOSPHERIC PROJECTILE THERMAL PROTE

TOPIC# 2

OFFICE:

THE PROJECTILE THERMAL PROTECTION SYSTEM (TPS) IS CRITICAL TO THE APPLICATION OF HYPERVELOCITY GUN (HVG) KINETIC ENERGY WEAPONS FOR ENDOATMOSPHERIC MISSIONS. PROJECTILE AERODYNAMIC HEATING, MELTING, AND ABLATION LIMIT THE VELOCITY POTENTIAL OF PROMISING HVG CONCEPTS. RESEARCH IS BEING UNDERTAKEN TO IDENTIFY OPTIMUM PROJECTILE TPS MATERIALS, QUANTIFY THEIR PERFORMANCE, DEFINE MATERIAL IMPROVEMENT OPPORTUNITIES, AND PLAN HYPERVELOCITY PROJECTILE TPS DEMONSTRATIONS. SOPHISTICATED COMPUTER PROGRAMS ARE BEING USED TO QUANTIFY AERODYNAMIC HEATING AND ABLATION THERMOCHEMISTRY FOR A RANGE OF TRAJECTORY CONDITIONS. OPTIMUM TPS MATERIALS ARE BEING IDENTIFIED FOR THREE REGIMES: WHERE ABLATION IS AVOIDABLE, WHERE ABLATION IS UNAVOIDABLE BUT TOLERABLE, AND WHERE ACTIVE COOLING IS REQUIRED. THE VELOCITY AND RANGE ENVELOPES OF THESE REGIMES AND THE INFLUENCE OF OTHER PARAMETERS

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IS BEING QUANTIFIED. FOR THE ABLATION REGIME, CHARTS OF SURFACE RECESSON ARE BEING GENERATED. TPS EFFECTS ON THE PROJECTILE SYSTEM DESIGN AND PERFORMANCE (E.G., DRAG, ACCURACY) ARE BEING INVESTIGATED. THIS RESEARCH MAY SHOW THAT TUNGSTEN IS THE OPTIMUM TPS MATERIAL FOR ALL BUT THE HIGHEST VELOCITIES, WHICH WOULD SIMPLIFY HYPERVELOCITY PROJECTILE DESIGNS. IT IS ANTICIPATED THAT CARBON-CARBON AND ACTIVE COOLING (E.G., TRANSPIRATION OR GAS-JET) TPS WILL BE REQUIRED FOR INCREASINGLY HIGHER VELOCITIES AND RANGES.

ASTROSYSTEMS INC (ASTROPOWER DIV)

30 LOVETT AVE  
NEWARK, DE 19711

CONTRACT NUMBER:

JAMES B McNEELY

TITLE:

ELECTRONIC GaAs-ON-SILICON MATERIAL FOR ADVANCED HIGH-  
OPTOELECTRONIC DEVICES

TOPIC# 14 OFFICE:

THE SUCCESSFUL GROWTH OF GaAs ON SILICON SUBSTRATES USING DOUBLE SELECTIVE LIQUID EPITAXIAL (DSLE) PROCESS HAS RECENTLY BEEN ACCOMPLISHED. THESE RESULTS SET THE STAGE FOR THE DEVELOPMENT OF AN EXTREMELY USEFUL MATERIAL--LARGE PLANAR WAFERS OF SMOOTH GaAs ON SILICON. DOUBLE SELECTIVE LIQUID PHASE EPITAXY COULD SIGNIFICANTLY REDUCE THE PROBLEMS CAUSED BY LATTICE MISMATCH AND DIFFERENTIAL THERMAL EXPANSION BY REDUCING THE AREA OF CONTACT BETWEEN ADJACENT SEMICONDUCTOR LAYERS TO SMALL NUCLEATION VIAS ONLY MICRONS IN DIAMETER. SMOOTH, PLANAR LOW-DISLOCATION GALLIUM ARSENIDE OVERGROWTH IS BEING PREPARED BASED ON THE DSLE PROCESS BY CONTROLLING THE THERMOCHEMISTRY AND KINETICS OF THE GaAs OVERLAYER GROWTH TO ELIMINATE FACETING. LIQUID PHASE EPITAXY IS EXPECTED TO RESULT IN LOWER RESIDUAL BACKGROUND IMPURITY LEVELS THAN OTHER GROWTH TECHNIQUES. STABLE SEMI-INSULATING GaAs LAYERS ARE BEING PREPARED BY LOW LEVEL DOPING WITH A DEEP LEVEL ACCEPTOR. MATERIAL QUALITY AND UNIFORMITY ARE BEING DEMONSTRATED BY FABRICATING SIMPLE MAJORITY AND MINORITY CARRIER DEVICES. A FEASIBILITY STUDY AND EQUIPMENT DESIGN FOR 16 SQUARE INCH GaAs-ON-SILICON WAFERS IS BEING COMPLETED.

ASTROSYSTEMS INC (ASTROPOWER DIV)

30 LOVETT AVE  
NEWARK, DE 19711

CONTRACT NUMBER:

JAMES B McNEELY

TITLE:

HIGH EFFICIENCY GaAs SOLAR CELL ENHANCEMENT WITH InAsP  
SOLAR CELL

TOPIC# 5 OFFICE:

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SOLAR ENERGY CONVERSION EFFICIENCY OF GALLIUM ARSENIDE SOLAR CELL ARRAYS CAN BE ENHANCED SUBSTANTIALLY BY USING A 0.99EV BOTTOM SOLAR CELL UNDER THE GaAs SOLAR CELL IN A TWO-CELL CASCADE STACK. EFFICIENCIES COULD INCREASE FROM 21.2% FOR PRACTICAL GaAs SOLAR CELLS TO 28.2% FOR THE TWO-CELL STACK. A BOTTOM SOLAR CELL BASED ON THE InAsP TERNARY MATERIAL SYSTEM IS BEING DEVELOPED FOR SPACE APPLICATIONS. SOLAR CELLS IN THE GaAsP SYSTEM HAVE BEEN PREPARED WITH LATTICE PARAMETER DIFFERENCES OF 2.41% FROM THE TRANSPARENT GAP SUBSTRATE USING LIQUID PHASE EPITAXY TECHNIQUES AND SIMILAR TECHNIQUES ARE BEING EMPLOYED FOR PREPARING THE InAsP 0.99EV BOTTOM SOLAR CELLS. THIS INVESTIGATION HAS THE ADVANTAGE OF DRAWING FROM THE WELL ESTABLISHED HIGH PERFORMANCE TECHNOLOGY BASE IN GaAs SOLAR CELLS AND IN GaInAsP FIBER OPTIC EMITTERS AND SEMICONDUCTOR LASERS. InAsP IS A DIRECT BANDGAP SEMICONDUCTOR WHICH LEADS TO HIGHER CURRENTS, HIGHER QUANTUM EFFICIENCY AND THE POTENTIAL FOR BETTER RESISTANCE TO RADIATION DEGRADATION THAN INDIRECT SEMICONDUCTORS SUCH AS SILICON. THE HIGH PERFORMANCE OF GALLIUM ARSENIDE COMBINED WITH THE INDIUM-BASED TERNARY TECHNOLOGY IS ANTICIPATED TO ACHIEVE A NEW GENERATION OF HIGH PERFORMANCE PHOTOVOLTAIC SOLAR CELL SYSTEMS WITH INCREASED EFFICIENCY, LIGHTER WEIGHT, AND IMPROVED RELIABILITY IN THE SPACE ENVIRONMENT.

BIO-IMAGING RESEARCH INC  
425 BARCLAY BLVD  
LINCOLNSHIRE, IL 60069  
CONTRACT NUMBER:  
DR NAND K GUPTA  
TITLE:  
HIGH EFFICIENCY HARDENED X-RAY DETECTORS  
TOPIC# 3                      OFFICE:

WHILE A NUMBER OF TECHNIQUES EXIST FOR X-RAY AND GAMMA-RAY DETECTION, NONE OF THEM OFFER THE DESIRABLE COMBINATION OF HIGH ABSORPTION (OR STOPPING POWER) AND GOOD DIRECTIONAL LOCALIZATION OR IMAGING. THE FEASIBILITY OF FABRICATING DETECTORS OF THIN SINGLE-CRYSTAL WAFERS OR NEEDLES IS BEING INVESTIGATED WITH SUFFICIENTLY HIGH DENSITY AND LENGTH IN THE DIRECTION OF THE PHOTON FLUX TO GET HIGH STOPPING POWER. NEW TYPES OF X-RAY AND GAMMA-RAY DETECTORS ARE BEING DESIGNED THAT ARE EXPECTED TO STOP OVER 99% OF IMPINGING PHOTONS AT 0.5MEV AND OVER

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50% AT 8MEV. THE SCINTILLATORS WOULD BE CLOSELY PACKED SO AS TO LOSE FEW PHOTONS IN THE SPACES BETWEEN SCINTILLATORS. SUCH DETECTORS WOULD LEND THEMSELVES TO SOURCE DISCRIMINATION VIA MULTIPLE-ENERGY TECHNIQUES. THE RESULTS WOULD BE ACHIEVED BY A COMBINATION OF PHYSICAL DESIGN AND SIGNAL PROCESSING. A DETERMINATION IS BEING MADE WHETHER LINE ARRAYS OR AN AREA ARRAY IS MOST SUITABLE, AND A SPECIFIC GEOMETRY IS BEING SELECTED. SPECTRAL REQUIREMENTS ARE BEING REVIEWED, A RECOMMENDATION IS BEING MADE WHETHER ONE, TWO, OR MORE SPECTRAL BANDS SHOULD BE INCLUDED. A PRELIMINARY ANALYSIS OF SIZE AND WEIGHT IS BEING MADE TO DETERMINE FABRICATION FEASIBILITY AND TO ENSURE THAT ANY UNUSAL CONFIGURATIONS CAN BE BUILT.

BRIMROSE CORP OF AMERICA  
7720 BELAIR RD  
BALTIMORE, MD 21236

CONTRACT NUMBER:

DR RONALD G ROSEMEIER

TITLE:

HYBRID MICROCOMPUTER-BASED OPTICAL SIGNAL PROCESSOR UT  
TWO-DIMENSIONAL ACOUSTO-OPTIC MODULATOR

TOPIC# 11 OFFICE:

WITH THE INTEREST IN THE DEVELOPMENT OF VERY FAST COMPUTERS, MUCH FASTER THAN THE CONVENTIONAL DIGITAL CHIP-BASED SYSTEM, THE FUTURE SEEMS VERY BRIGHT FOR OPTICAL-SIGNAL PROCESSING. TWO-DIMENSIONAL OPTICAL PROCESSING IS BEING USED FOR PATTERN RECOGNITION, MACHINE VISION, AND OPTICAL COMPUTING. CURRENTLY, A MAGNETO-OPTIC SPATIAL LIGHT MODULATOR (MOSLM) IS USED TO CONVERT ARRAYS OF PROGRAMMABLE ELECTRONIC SIGNALS DERIVED FROM A MICROCOMPUTER INTO TWO-DIMENSIONAL, ADDRESSABLE DATA. A UNIQUE 2-D ACOUSTO-OPTIC SPATIAL LIGHT MODULATOR (AOSLM) (INSTEAD OF A MOSLM) IS BEING CONSTRUCTED AS A SIGNAL PROCESSOR COMPONENT WHICH CAN BE USED IN AN OPTICAL COMPUTER ARRANGEMENT. THIS DEVICE UTILIZES A UNIQUE TECHNOLOGY OF FABRICATING GIGAHERTZ (GHZ) ACOUSTO-OPTIC BRAGG CELLS (1-D SPATIAL LIGHT MODULATORS). COMPUTER MODELING IS BEING UNDERTAKEN TO OBTAIN THE PROPER DIRECTIONS FOR OPTIMUM DEVICE PERFORMANCE FOR A 2-D GAP SPATIAL LIGHT MODULATOR. THE DEVICE IS BEING CONSTRUCTED AND TESTED. REAL-TIME PROGRAMMABLE OPTICAL SIGNAL PROCESSOR SYSTEM AND 2-D SPATIAL LIGHT MODULATOR IS BEING DESIGNED. BENEFITS OF THE AOSLM OVER THE

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MOSLM IS HIGHER BANDWIDTH, INCREASE OF RESOLUTION AND LESS LOSS OF  
LASER INTENSITY.

BUSEK J CO INC  
486 QUINOBEQUIN RD  
NEWTON, MA 02168  
CONTRACT NUMBER:  
DR VLADIMIR J HRUBY  
TITLE:  
SPACE-BASED DISK MAGNETOHYDRODYNAMIC POWER SYSTEMS  
TOPIC# 5                      OFFICE:

THE APPLICABILITY OF COMBUSTION-DRIVEN MAGNETOHYDRODYNAMIC (MHD)  
GENERATORS FOR STRATEGIC DEFENSE PURPOSES IS CLEARLY ESTABLISHED. ONE  
ISSUE REMAINING TO BE EXAMINED IS THE CHOICE OF MHD GENERATOR GEOMETRY  
- LINEAR VERSUS DISK. A GROUND-BASED DEMONSTRATION PROGRAM OF A  
SPACE-BASED MHD DISK GENERATOR IS BEING UNDERTAKEN. THE DISK  
GENERATOR IS BEING DRIVEN BY UNCONVENTIONALLY ARRANGED SOLID FUEL  
ROCKET MOTORS WITH A TOTAL MASS FLOW OF 20 KG/SEC. THE SOLID FUEL WAS  
CHOSEN OVER THE LIQUID ALTERNATIVE BECAUSE OF THE LOWER COST AND  
REDUCED COMPLEXITY OF THE FEASIBILITY DEMONSTRATION SYSTEM. THE  
PROJECTED ELECTRICAL POWER OUTPUT IS ON THE ORDER OF 20 MW. CHANNEL  
LOFT CALCULATIONS ARE BEING PERFORMED FOR GENERATORS: ONE LOFT FOR  
RADIAL FLOW DISK; ONE FOR A DISK WITH INLET SWIRL. CHEMICAL  
EQUILIBRIUM CALCULATIONS ARE BEING MADE TO ASCERTAIN MAXIMUM RATE OF  
REACTANT EXPANSION WHILE AVOIDING FROZEN FLOW AND MHD NONEQUILIBRIUM  
CONDITIONS. CONCEPTUAL DESIGN OF THE TWO TYPES OF GENERATORS IS BEING  
DEVELOPED PLACING EMPHASIS ON SIDEWALL SEGMENTATION AND METHODS OF  
COOLING HIGH HEAT FLUX AREAS. PROMISING CESIUM CONTAINING REACTANTS  
ARE BEING IDENTIFIED AND ANALYTICALLY EVALUATED. CONCEPTUAL DESIGN OF  
THE GAS GENERATOR/DISK CHANNEL INTERFACE IS BEING UNDERTAKEN.

BUSINESS & TECHNOLOGICAL SYSTEMS INC  
14504 GREENVIEW DR - STE 500  
LAUREL, MD 20708  
CONTRACT NUMBER:  
JAMES V CARROLL  
TITLE:  
IDENTIFICATION AND CONTROL ALGORITHMS OF LARGE SPACE  
STRUCTURES  
TOPIC# 12                      OFFICE:

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THE NEED FOR RAPID AND ACCURATE SLEWING AND POINTING CONTROL PERFORMANCE HAS FORCED DESIGNERS OF LARGE SPACE STRUCTURE (LSS) CONTROL SYSTEMS TO SEEK NEW CONTROL TECHNIQUES. ADAPTIVE CONTROL IS TREATED WITH CAUTION BY CURRENT RESEARCHERS BECAUSE OF THE NEED FOR ACCURATE SYSTEM MODELS. RECENTLY DEVELOPED IDENTIFICATION METHODS ARE BEING INVESTIGATED AS AN APPROACH TO OBTAINING HIGH ACCURACY MODELS IN REAL TIME FROM MEASUREMENTS ALREADY USED BY CLOSED LOOP CONTROLLERS. IN ADDITION, IDENTIFICATION IS BEING COMBINED WITH A ROBUST ADAPTIVE CONTROL ALGORITHM THAT HAS MOST RECENTLY BEEN SUCCESSFULLY ADAPTED TO BATTLE DAMAGE RECONFIGURATION OF FIGHTER AIRCRAFT AUTOPILOTS. THIS MAJOR OBJECTIVE IS BEING ACHIEVED BY DEVELOPING AN APPROPRIATE LSS MODEL. TEST POINTING AND SLEWING MANEUVERS ARE BEING DEVELOPED USING THE LSS MODEL AND STANDARD BASELINE CONTROLLERS. THE NEW SUBSYSTEM MODULES ARE BEING ADAPTED TO THE LSS CONTROL DESIGN, AND PERFORMANCE IS BEING COMPARED TO THE BASELINE. THE MERGING OF THESE TECHNIQUES AND THEIR ENHANCEMENT ACHIEVED BY EXPLORING NEW ADVANCES IN PROCESSOR HARDWARE AND IN SUITABLE, EFFICIENT AND FAST SOFTWARE ALGORITHMS COULD RESULT IN A STABLE PRODUCT FOR USE IN FACTORY AUTOMATION APPLICATIONS, POWER PLANT CONTROL, AIR TRAFFIC CONTROL, AND FLIGHT CONTROL SYSTEMS FOR AIRCRAFT AND HELICOPTERS.

BUSINESS & TECHNOLOGICAL SYSTEMS INC  
14504 GREENVIEW DR - STE 500  
LAUREL, MD 20708  
CONTRACT NUMBER:  
JAMES V CARROLL  
TITLE:  
RECONFIGURATION ALGORITHMS FOR ENHANCING SURVIVABILITY  
PLATFORMS  
TOPIC# 8                      OFFICE:

GIVEN THE INEVITABILITY IN SPACE-BASED STRATEGIC DEFENSE SYSTEMS OF DAMAGE OR SERIOUS DEGRADATION TO ONE OR MORE SYSTEM COMPONENTS, THE REMAINING OPERABLE COMPONENTS MUST BE ABLE TO BE RECONFIGURED TO PERFORM OPTIMALLY THE SPACE PLATFORM MISSION. REDUNDANCY IS NOT A FEASIBLE OR APPROPRIATE ALTERNATIVE IN MANY CASES. IN THOSE INSTANCES, SURVIVABILITY ENHANCEMENT COULD BE IMPROVED GREATLY BY ADDING INTELLIGENCE TO APPROPRIATE SYSTEMS IN THE FORM OF A SELF-CONTAINED RECONFIGURATION CAPABILITY. RELIABLE FAULT DETECTION

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SCHEMES ARE BEING DEMONSTRATED THAT WILL QUANTIFY SUDDEN FAILURES AND ALLOW RECONFIGURATION LOGIC TO SELECT A COURSE OF ACTION MOST APPROPRIATE FOR THE TYPE OF DAMAGE SUFFERED WITH MINIMAL PERFORMANCE IMPACT. THE MOST LIKELY PLATFORM SUBSYSTEM FOR THIS RECONFIGURATION CAPABILITY IS THE ATTITUDE AND POINTING CONTROL SYSTEM. IN ADDITION, SURVEILLANCE, OPTICAL AND WEAPON SYSTEMS ARE BEING ANALYZED AS TIME ALLOWS. BY ADAPTING FDI AND ADAPTIVE CONTROL ALGORITHMS FROM THEIR PROVEN FIGHTER AIRCRAFT RECONFIGURATION APPLICATION TO THE SPACE PLATFORM PROBLEM, APPROPRIATE DYNAMIC SYSTEM AND DISTURBANCE SIMULATIONS ARE BEING DEVELOPED ALONG WITH PERFORMANCE TEST SCENARIOS. THE RESULTING PLATFORM RECONFIGURATION SYSTEM, DESIGNED PRIMARILY FOR ATTITUDE AND POINTING CONTROL, IS BEING TESTED AGAINST BASELINE (NO RECONFIGURATION) RESULTS.

BUSINESS & TECHNOLOGICAL SYSTEMS INC  
14504 GREENVIEW DR - STE 500  
LAUREL, MD 20708  
CONTRACT NUMBER:  
WALLACE E LARIMORE  
TITLE:  
SYSTEM IDENTIFICATION AND CONTROL USING SINGULAR VALUE  
DECOMPOSITION SYSTOLIC ARRAYS  
TOPIC# 10                      OFFICE:

CURRENTLY AVAILABLE ALGORITHMS FOR SYSTEM IDENTIFICATION AND CONTROL ARE NOT COMPLETELY RELIABLE FOR AUTOMATIC IMPLEMENTATION ON MICROPROCESSORS IN REAL TIME. A NEW CLASS OF ALGORITHMS BASED UPON A GENERALIZED SINGULAR VALUE DECOMPOSITION IS BEING CONSIDERED FOR SYSTEM IDENTIFICATION, STATISTICAL MODEL ORDER DETERMINATION, MODEL ORDER REDUCTION, AND PREDICTIVE CONTROL. IN THIS APPROACH, THE ALGORITHMS ARE COMPUTATIONALLY STABLE AND NUMERICALLY ACCURATE AND CAN BE IMPLEMENTED ON SYSTOLIC ARRAY PROCESSORS USING RECENTLY DEVELOPED ALGORITHMS RESULTING IN A CONSIDERABLE SPEEDUP. THIS APPROACH IS BASED UPON A RECENT GENERALIZED CANONICAL VARIATE ANALYSIS METHOD FOR DETERMINING THE OPTIMAL STATE OF A RESTRICTED ORDER IN SYSTEM IDENTIFICATION, REDUCED ORDER STOCHASTIC FILTERING, AND MODEL PREDICTIVE CONTROL. THIS PERMITS A UNIFIED APPROACH TO THE SOLUTION OF THESE PROBLEMS FROM THE VIEWPOINTS OF A PREDICTION PROBLEM AS WELL AS AN APPROXIMATION PROBLEM. THIS INVESTIGATION, IF SUCCESSFUL, WOULD

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BENEFIT DEFENSE SYSTEMS THAT REQUIRE ONLINE ADAPTIVE CONTROL INCLUDING FLUTTER SUPPRESSION, FAILURE DETECTION, CONTROL OF LARGE SPACE STRUCTURES, AND TARGET DETECTION AND TRACKING. COMMERCIAL APPLICATIONS INCLUDE CHEMICAL PROCESS CONTROL, CONTROL AND IDENTIFICATION OF POWER PLANTS, AND ADAPTIVE CONTROL IN INDUSTRIAL MANUFACTURING AND ROBOTICS.

CENTER FOR REMOTE SENSING  
8200 GREENSBORO DR - STE 503  
MCLEAN, VA 22102

CONTRACT NUMBER:

DR SUMAN GANGULY

TITLE:

INFRARED TRACKING PERFORMANCE IN THE PRESENCE OF STRIA  
NUCLEAR BACKGROUND

TOPIC# 3

OFFICE:

THE RELIABILITY OF A STRATEGIC DEFENSE SYSTEM DEPENDS CRITICALLY ON THE CAPABILITIES OF OPTICAL SENSORS TO TRACK REENTRY VEHICLES AGAINST A HIGHLY STRIATED NUCLEAR DISTURBED ATMOSPHERIC BACKGROUND. THIS INVESTIGATION USES COMPUTER CODES TO PERFORM A QUANTITATIVE ANALYSIS OF THE IMPACT OF NUCLEAR BACKGROUNDS ON ANGLE-ONLY OR STEREO VIEWING TRACKING SYSTEMS. AN EVALUATION OF THE FOLLOWING CRITICAL VARIABLES IS BEING PERFORMED: STRIATION PARAMETERS; PLATFORM LOCATION RELATIVE TO THE EARTH'S MAGNETIC FIELD AND TO THE WIND VELOCITY; AND IMPROVED TRACKING POSSIBLE FROM USE OF MULTIPLE PLATFORM SYSTEMS. THE RESULTS OF THIS STUDY WILL PROVIDE THE GROUNDWORK FOR THE DEVELOPMENT OF A COMPUTER CODE WHICH WILL INCORPORATE ATMOSPHERIC REALIZATIONS BASED ON THE MODEL OF A NUCLEAR STRIATED ATMOSPHERE, AND FROM WHICH SENSITIVITY STUDIES CAN BE CARRIED OUT.

CERAM-PHYSICS INC  
921 EASTWIND DR - STE 110  
WESTERVILLE, OH 43081

CONTRACT NUMBER:

W N LAWLESS

TITLE:

SOLID STATE OXYGEN COMPRESSOR FOR JOULE-THOMPSON CRYOC

TOPIC# 3

OFFICE:



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THE SIGNAL-TO-NOISE RATIO OF INFRARED DETECTORS INCREASES DRAMATICALLY AS THE TEMPERATURE OF THE DETECTOR IS REDUCED TO CRYOGENIC TEMPERATURES AND THERE HAS BEEN A SUBSTANTIAL IMPROVEMENT IN CRYOCOOLERS TO MEET THIS NEED. HOWEVER, VALVES OF ONE TYPE OF CRYOCOOLER, THE JOULE-THOMPSON EXPANSION CRYOCOOLER, ARE PRONE TO PLUGGING BY THE FREEZING OF IMPURITIES IN THE HIGH-PRESSURE STREAM. TO ADDRESS THIS PROBLEM, A RADICAL APPROACH FOR PROVIDING A HIGH-PRESSURE GAS STREAM OF 100% PURE OXYGEN TO A JOULE-THOMPSON EXPANSION DEVICE IS BEING INVESTIGATED. THE COMPRESSOR, A MONOLITHIC SOLID-STATE DEVICE CONTAINING NO MOVING PARTS, IS BASED ON THE SELECTIVE TRANSPORT OF OXYGEN IONS THROUGH A CERAMIC OXYGEN IONIC CONDUCTOR UNDER AN APPLIED VOLTAGE. ELEMENTARY CONSIDERATIONS SHOW THAT THE CERAMIC STRUCTURE MUST HAVE A VERY LOW RESISTANCE, THEREBY ELIMINATING THE PARTIALLY STABILIZED ZIRCONIAS. THE FEASIBILITY OF AN ALTERNATIVE, PROPRIETARY CERAMIC IS BEING ASSESSED THAT OFFERS TWO OUTSTANDING ADVANTAGES: OXYGEN IONIC CONDUCTIVITIES 30-50 LARGER THAN THE BEST ZIRCONIAS AND FAVORABLE SINTERING TEMPERATURES FOR FABRICATING VERY LOW RESISTANCE CELLULAR-HONEYCOMB STRUCTURES. BASED ON MEASURED OXYGEN-GENERATION RATES, MODEL CALCULATIONS ARE BEING CARRIED OUT FOR VARIOUS HONEYCOMB-TYPE GEOMETRIES TO STUDY POWER CONSUMPTION, PRESSURE, MASS-FLOW RATE, SIZE, AND EFFICIENCY. IDEAL JOULE-THOMPSON EXPANSION CYCLES ARE BEING STUDIED FOR REFRIGERATION CAPACITY AT TEMPERATURES 50-90K.

CHEMICAL DYNAMICS CORP  
9560 PENNSYLVANIA AVE - STE 106  
UPPER MARLBORO, MD 20772  
CONTRACT NUMBER:  
BRUCE C GARRETT  
TITLE:  
NITROCUBANE DECOMPOSITION  
TOPIC# 6                      OFFICE:

GAS-PHASE CHEMICAL REACTIONS PLAY AN IMPORTANT ROLE IN DETERMINING THE POWER AND SENSITIVITY OF ENERGETIC MATERIALS WHICH ARE USED AS FUELS IN DEFENSE PROPULSION SYSTEMS. THEORETICAL METHODS CAN PROVIDE DETAILED DYNAMIC INFORMATION ABOUT THE IMPORTANT CHEMICAL REACTIONS, THEREBY AIDING IN THE DESIGN OF NEW PROPELLANTS. THEORETICAL METHODS HAVE BEEN DEVELOPED, EXTENSIVELY TESTED, AND SHOWN TO BE APPLICABLE TO

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SMALL POLYATOMIC SYSTEMS (THREE ATOMS). THE FEASIBILITY IS BEING INVESTIGATED OF EXTENDING THESE METHODS TO DETERMINE REACTION PATHWAYS AND RATES FOR LARGER POLYATOMIC SYSTEMS IMPORTANT IN PROPELLANT DECOMPOSITION. ELECTRONIC STRUCTURE CALCULATIONS ARE BEING UNDERTAKEN TO OBTAIN POTENTIAL ENERGY SURFACE INFORMATION WHICH IS THEN USED IN DYNAMIC CALCULATIONS OF THE RATE CONSTANTS. THE SENSITIVITY OF THE COMPUTED RATE CONSTANTS TO THE LEVEL OF COMPUTATIONAL EFFORT IS BEING STUDIED FOR A FAIRLY SMALL REACTIVE SYSTEM (FIVE ATOMS) TO ASSESS THE FEASIBILITY OF EXTENDING THESE METHODS TO LARGE MORE DEMANDING POLYATOMIC SYSTEMS. THE BENEFITS OF THE RESEARCH, IF SUCCESSFUL, ARE THE ABILITY TO THEORETICALLY DETERMINE KINETIC DATA FOR GAS-PHASE CHEMICAL REACTIONS IMPORTANT IN PROPELLANT DECOMPOSITION AND TO PROVIDE INSIGHT INTO THE MECHANISM OF RADICAL ATTACK OF NITRO CONTAINING MOLECULES. THESE THEORETICAL METHODS WILL AID IN THE DEVELOPMENT OF PROPELLANTS WHICH ARE ENERGETIC YET STABLE.

CHEMTECH SYSTEMS INC  
PO BOX 1067  
BURLINGTON, MA 01803  
CONTRACT NUMBER:  
DR M L GOPIKANTH  
TITLE:  
CATHODES FOR HIGH ENERGY DENSITY RECHARGEABLE BATTERIE  
TOPIC# 5                      OFFICE:

LITHIUM-THIONYL CHLORIDE AND LITHIUM-SULFUR DIOXIDE BATTERY SYSTEMS HAVE HIGHEST ENERGY BUT CANNOT BE RECHARGED; THIS LIMITS THEIR USE IN MANY SPACE POWER APPLICATIONS. AN ALL INORGANIC AMBIENT TEMPERATURE RECHARGEABLE BATTERY BASED ON LITHIUM AND SULFUR DIOXIDE WOULD HAVE ONE OF THE HIGHEST THEORETICAL AND PRACTICAL ENERGY DENSITIES AND MIGHT POTENTIALLY SOLVE THE LITHIUM RECHARGEABLE BATTERY PROBLEMS. SUCH A HIGH ENERGY DENSITY, ALL INORGANIC, NON-AQUEOUS RECHARGEABLE BATTERY FOR SPACE APPLICATIONS IS BEING DEVELOPED. THIS SYSTEM COULD HAVE ENERGY DENSITY THAT WOULD MEET THE REQUIREMENTS OF STRATEGIC DEFENSE NEEDS, AND BURST POWER THAT COULD EASILY REACH HUNDREDS OF KW'S OF POWER. SUCH A BATTERY WOULD DEPEND UPON A NEW CATHODE, WHICH CAN ENABLE IMPROVEMENTS IN ITS PERFORMANCE, ESPECIALLY HIGH ENERGY, NUMBER OF CYCLES, OVER-CHARGE ABILITY, STORAGE LIFE, AND HIGH CURRENT CHARGE/DISCHARGE. BY VARYING THE CATHODES OF PROPERTIES, THIS BATTERY

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COULD BE TAILORED FOR VARIOUS APPLICATIONS, BOTH DEFENSE AND CIVIL.

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CONTRACT NUMBER:  
DR RICHARD A ATLES  
TITLE:  
OPTIMUM SENSOR FUSION FOR DETECTION OF LOW-OBSERVABILITY  
AND DISCRIMINATION AGAINST DECOYS AND JAMMING  
TOPIC# 3 OFFICE:

SENSOR FUSION ADDRESSES THE PROBLEM OF COMBINING OUTPUTS OF SENSORS THAT COVER A BROAD RANGE OF THE ELECTROMAGNETIC SPECTRUM IN ORDER TO DETECT LOW-OBSERVABILITY TARGETS AND TO DISCRIMINATE AGAINST DECOYS AND OTHER PENETRATION AIDS. MANY CURRENTLY POPULAR APPROACHES TO FUSION ARE SUBOPTIMAL BECAUSE THEY USE THRESHOLDED SENSOR OUTPUTS RATHER THAN THE OUTPUTS THEMSELVES. WELL ACCEPTED (BAYES OR NEYMAN-PEARSON) OPTIMALITY CRITERIA ARE BEING USED TO SUGGEST NEW FUSION METHODS INCORPORATING ENVIRONMENTALLY ADAPTIVE DISCRIMINANTS AND MULTIPLE HYPOTHESES ABOUT TARGET OR DECOY TYPES. THE ADVANTAGES OF OPTIMUM FUSION METHODS RELATIVE TO OTHER SUBOPTIMUM TECHNIQUES SUCH AS M OUT OF N DETECTORS (INCLUDING AND AND OR OPERATIONS) ARE BEING QUANTITATIVELY DEMONSTRATED. THE QUANTITATIVE DEMONSTRATION IS IN TERMS OF RECEIVER OPERATING CURVES OF THE FUSED SENSOR OUTPUT GIVEN THE RECEIVER OPERATING CURVES OF THE INDIVIDUAL SENSORS. MILITARY BENEFITS ARE THE OPTIMUM USE OF MULTIPLE SENSORS FOR SURVEILLANCE AND DISCRIMINATION AGAINST COUNTERMEASURES. COMMERCIAL BENEFITS INCLUDE THE OPTIMUM USE OF INFORMATION FROM DIFFERENT MEDICAL IMAGING DEVICES FOR MEDICAL DIAGNOSIS.

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TITLE:  
PYROELECTRIC BATTERY SYSTEMS  
TOPIC# 5 OFFICE:

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RECENT ADVANCES IN PYROELECTRICS HAVE PROVIDED MATERIALS WHICH MAY BE USEFUL IN THE DIRECT CONVERSION OF HEAT INTO ELECTRICAL ENERGY IN SPACE SYSTEMS. THESE MATERIALS COULD PROVIDE AN ULTRA-LIGHTWEIGHT MEANS OF GENERATING ELECTRICAL POWER FROM A THERMAL BATTERY SYSTEM WITH NO MOVING SOLID PARTS. ADVANCED PYROELECTRIC DEVICES APPEAR CAPABLE OF EXCEEDING 30% EFFICIENCY. DUE TO ITS PROJECTED HIGHER EFFICIENCY, THE PYROELECTRIC APPROACH WILL BE SMALLER BY A FACTOR OF TWO IN SOLAR COLLECTOR AREA THAN PHOTOVOLTAICS. THE FEASIBILITY IS BEING DEMONSTRATED EXPERIMENTALLY THAT CERTAIN COPOLYMERS CAN PRODUCE ELECTRICAL POWER AT HIGHER TEMPERATURES THAN PRESENTLY AVAILABLE WITH EXISTING MATERIALS. TWO NEW COMPOSITIONAL RATIOS OF COPOLYMER RESIN ARE BEING SYNTHESIZED. TEST SPECIMENS ARE BEING FABRICATED FROM THE RESINS, AND THERMAL-ELECTRICAL CYCLING MEASUREMENTS PERFORMED. ELECTRIC DISPLACEMENT VERSUS ELECTRIC FIELD BEHAVIOR OF THE PYROELECTRIC COPOLYMER IS BEING MEASURED DURING ELECTRIC ERICSSON/BRAYTON CYCLING AT ELEVATED TEMPERATURES (UP TO 140C). BASED ON THE RESULTS OF THE MEASUREMENTS, AN ENGINEERING AND ECONOMIC ANALYSIS IS BEING PREPARED.

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DR DAVID GLOECKNER  
TITLE:  
KINETIC KILL VEHICLE INITIAL POINTING ALGORITHMS  
TOPIC# 2                      OFFICE:

IN THE SPACE-BASED KILL VEHICLE BATTLE SCENARIO, THE INTERCEPTOR/TARGET ENGAGEMENT RANGES ARE USUALLY LARGE AND THE ENERGY AVAILABLE TO THE INTERCEPTOR FOR COURSE CORRECTION IS LIMITED. THE LARGE ENGAGEMENT RANGES INVOLVED MEAN THAT EVEN A SMALL POINTING ERROR AT LAUNCH (LAUNCH HEADING ANGLE) RESULTS IN LARGE PROJECTED MISS DISTANCE REQUIRING AN EXCESSIVE AMOUNT OF ENERGY TO CORRECT FOR THE MISS DISTANCES. THESE CONSIDERATIONS SUGGEST THAT IS IS IMPORTANT TO SELECT THE INTERCEPTOR POINTING VECTOR AT LAUNCH SUCH THAT THE FLIGHT TRAJECTORY IS "CLOSE" TO THE COLLISION COURSE, GIVEN THAT THERE ARE NO ADDITIONAL TARGET MANEUVERS. IN THE PAST, THIS POINTING PROBLEM ISSUE HAD BEEN ADDRESSED BY ASSUMING A CONSTANT VELOCITY AND ACCELERATION

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VECTOR AND BY IGNORING THE GRAVITATIONAL EFFECTS. THE STRATEGIC DEFENSE INTERCEPTOR POINTING PROBLEM WITH ACCELERATION AND GRAVITY EFFECTS TAKEN INTO ACCOUNT BECOMES A COMPLEX PROBLEM, AND A CLOSED FORM EXPRESSION FOR THE POINTING VECTOR CANNOT BE FOUND. A BASELINE ITERATIVE ALGORITHM IS BEING INVESTIGATED THAT COMPUTES THE POINTING VECTOR THAT LEADS TO A COLLISION COURSE TRAJECTORY. THE INTERCEPTOR LAUNCH CONDITIONS, ITS BOOST PHASE, AND THE GRAVITY EFFECTS ARE BEING TAKEN INTO ACCOUNT. THE STUDY IS DEVELOPING AND TESTING THE ALGORITHM AND COMPARING ITS SPEED AND ACCURACY WITH ALTERNATIVE ALGORITHMS.

COMBUSTION SCIENCES INC  
208 ELMWOOD RD  
CHAMPAIGN, IL 61821  
CONTRACT NUMBER:  
DR HERMAN KRIER  
TITLE:  
LASER PROPULSION THRUSTERS  
TOPIC# 6                      OFFICE:

LASER ROCKET PROPULSION RESEARCH RECENTLY HAS DEMONSTRATED SUBSTANTIAL POTENTIAL FOR THE CONVERSION OF HIGH POWER LASER ENERGY INTO THERMAL PROPULSIVE ENERGY, USING EITHER CONTINUOUS OR PULSED MODE LASER SOURCES. IT IS NOW POSSIBLE FOR THE FIRST TIME TO DEVELOP PROTOTYPE DESIGNS FOR ACTUAL LASER PROPULSION THRUSTERS THAT CAN BE BUILT AND TESTED AT REALISTIC LASER POWERS. TO ACCOMPLISH THIS, PREVIOUS LASER PROPULSION RESEARCH IS BEING REVIEWED, VARIOUS ENERGY CONVERSION TECHNIQUES EVALUATED, IMPORTANT SYSTEM QUESTIONS EXAMINED, AND EXISTING NUMERICAL MODELS USED TO DEVELOP SCALING LAWS AND QUANTIFY THRUSTER PERFORMANCE AT VERY HIGH LASER POWERS. BASELINE DESIGNS FOR ACTUAL LASER PROPULSION THRUSTERS ARE BEING DEVELOPED; DEVICES WHICH COULD LATER BE BUILT AND TESTED.

COMPTEK CORP  
2400 SCHOENERSVILLE RD - RD4  
ALLENTOWN, PA 18103  
CONTRACT NUMBER:  
GEORGE C SIH  
TITLE:  
KINETIC ENERGY IMPACT ASSESSMENT METHODOLOGY  
TOPIC# 9                      OFFICE:

SUBMITTED BY  
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A METHODOLOGY FOR ASSESSING TARGET LETHALITY IS BEING INVESTIGATED SUCH THAT THE HIERARCHY OF DAMAGE STATES CAUSED BY HYPERVELOCITY IMPACT CAN BE PREDICTED AS THE HARDNESS AND/OR TOUGHNESS OF THE TARGET MATERIAL IS ALTERED. THE DYNAMIC RESPONSE OF THE PROJECTILE AND TARGET MATERIAL IS BEING DERIVED BY KNOWING ONLY THE STATIC UNIAXIAL DATA FOR A SUFFICIENTLY SMALL INITIAL LOAD STEP. CHANGE IN LOCAL STRAIN RATES AND STRAIN RATE HISTORY IS BEING DERIVED ANALYTICALLY IN ADDITION TO DETERMINING PHASE TRANSITION OF TARGET FROM SOLID TO LIQUID AND LIQUID TO GAS. IN CONTRAST TO THE CONVENTIONAL APPROACH, THE DAMAGE PATTERN OF A PROJECTILE/TARGET SYSTEM IS BEING OBTAINED SHORTLY AFTER IMPACT. ANTICIPATED POTENTIAL APPLICATIONS WILL ENHANCE THE DYNAMIC INTEGRITY OF BALLISTIC MISSILES AS THE METHOD CAN BE EXTENDED TO OBLIQUE HYPERVELOCITY IMPACT OF MULTI-LAYER STRUCTURES AND PROVIDE INFORMATION ON SUBSCALING OF HYPERVELOCITY PROJECTILE/TARGET SYSTEMS SO AS TO MINIMIZE OR AVOID FULL SCALE TESTS. THIS INVESTIGATION, IF SUCCESSFUL, HAS COMMERCIAL APPLICATION IN GENERATING TIME DEPENDENT STRESS AND STRAIN DATA FOR A WIDE RANGE OF STRAIN RATES.

CORDEC CORP  
8270-B CINDER BED RD  
LORTON, VA 22079  
CONTRACT NUMBER:  
DR RAYMOND J WEIMER  
TITLE:  
NIOBIUM NITRIDE SUPERCONDUCTING ELEMENTS FOR ELECTROMA  
RAIL GUNS AND PLASMA GUNS  
TOPIC# 2                      OFFICE:

HIGH ENERGY LASERS, PARTICLE BEAM WEAPONS, AND ELECTROMAGNETIC GUNS REQUIRE DELIVERY OF UNPRECEDENTED AMOUNTS OF ELECTRICAL ENERGY IN VERY SHORT TIMES. STORING AND DISTRIBUTING POWER ON THIS SCALE IS MORE EFFICIENT AND EFFECTIVE BY UTILIZING SUPERCONDUCTING ELEMENTS TO THE MAXIMUM EXTENT. NIOBIUM NITRIDE (NBN) HAS EMERGED AS THE BEST CANDIDATE ON THE BASIS OF ITS HIGH TRANSITION TEMPERATURE, HIGH CRITICAL CURRENT, AND HIGH CRITICAL FIELD IN THIN FILMS. MOREOVER, NBN SUPERCONDUCTORS ARE UNIQUELY RESISTANT TO RADIATION AND ARE INSENSITIVE TO ELASTIC STRAIN DEGRADATION OF THE CRITICAL FIELDS AND TEMPERATURES. USING NEWLY DEVELOPED VAPOR DEPOSITION PROCESSES FOR

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PRODUCING STRUCTURAL METAL MATRIX COMPOSITES, NBN THIN FILM PROPERTIES ARE BEING EXPLORED FOR FABRICATING HIGH-PERFORMANCE COMPACT POWER FEEDS FOR MEGAMPERE SYSTEMS. THESE NEW SUPERCONDUCTING COMPOSITES ARE BEING EVALUATED IN TERMS OF SUPERCONDUCTING PROPERTIES, MECHANICAL PROPERTIES, AND MICROSTRUCTURES TO ESTABLISH GUIDELINES FOR A SCALE-UP AND OPTIMIZATION OF THE PROCESSES AND FOR DESIGN AND CONSTRUCTION OF PROTOTYPE HARDWARE DEMONSTRATION PIECES AT A LATER PHASE. SIGNIFICANTLY LOWER COSTS, IMPROVED RADIATION RESISTANCE AND THERMOMECHANICAL STABILITY, AND MORE FLEXIBLE DESIGN OPTIONS SHOULD FACILITATE CONSTRUCTION OF HIGH-FIELD MAGNETS AND HIGH POWER DENSITY CONDUCTORS FOR ENERGY TRANSFER AND STORAGE.

CORIOLIS CORP  
15315 SOBEY RD  
SARATOGA, CA 95070  
CONTRACT NUMBER:  
ARTHUR H IVERSEN

TITLE:  
HIGH HEAT FLUX THERMAL MANAGEMENT IN SPACE PRIME POWER  
AND OTHER DEVICES  
TOPIC# 7                      OFFICE:

A NEW CLASS OF LIQUID COOLED HEAT EXCHANGE SURFACES PREVIOUSLY HAS BEEN DEMONSTRATED THAT COULD CONTRIBUTE TO THE DEVELOPMENT OF COMPACT, LIGHTWEIGHT SPACE-BASED PRIME POWER SYSTEMS. BENEFITS ARE HIGH FLUX REMOVAL AND SUBSTANTIAL WEIGHT REDUCTION IN COOLANT PUMP WEIGHT. A SIMPLIFIED SPACE REACTOR CALCULATION INDICATES A 432 HP PUMP FOR CONVENTIONAL COOLING VS 1 HP FOR A NEW PROPRIETARY TECHNOLOGY AT 20 MW/M SQUARED FOR A 60 MW RATING. AT 60 MW/M SQUARED FOR A 180 MW RATING, 18,560 HP AND 23 HP RESPECTIVELY, WOULD BE REQUIRED. HEAT TRANSFER IS UNAFFECTED BY ZERO "G" (SPACE) OR HIGH "G" (MANEUVERING PLATFORM) OPERATION. THE PREVIOUS PROOF OF PRINCIPLE DEMONSTRATED 60 MW/M SQUARED WITH 200 MW/M SQUARED CONSIDERED A PRACTICAL LIMIT. THE CURRENT EFFORT IS BEING DIRECTED TO AN INITIAL FLUID MECHANICS ANALYSIS AND DESIGN OF A LARGE AREA PLANAR ELECTRON GUN AND COLLECTOR. THE TEST VEHICLE FOR A LATER PHASE WOULD BE THE ABOVE COLLECTOR OPERATED TO 100 KW TO DEMONSTRATE 20 MW/M SQUARED DISSIPATION WITH 60 MW/M SQUARED AS A GOAL. FUTURE STUDIES WOULD ADDRESS 200 MW/M SQUARED OPERATION.

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CORY LABS INC  
1436 VIEW POINTE AVE  
ESCONDIDO, CA 92027  
CONTRACT NUMBER:  
DR J S CORY  
TITLE:  
SOUND AMPLIFICATION BY STIMULATED EMISSION  
TOPIC# 2                      OFFICE:

SOME EVIDENCE IS AVAILABLE THAT THE PHASE TRANSFORMATION ENERGY OF NITINOL CAN BE TRANSFORMED INTO SONIC ENERGY. IF A DEVICE CAN BE BUILT WHICH ALLOWS THIS CONVERSION, THE RESULTING AMPLIFIED SOUND WAVE MOTION AT A NITINOL SURFACE COULD BE USED TO ACCELERATE A HYPERVELOCITY PROJECTILE TO SONIC SPEED (5 KM/SEC) AND ABOVE. THE COUPLING BETWEEN THE NITINOL SURFACE AND THE PROJECTILE WOULD PROVIDE THE PRESSURE PADS SUCCESSFULLY USED IN PIEZOELECTRIC MOTORS. THE CRITICAL REQUIREMENT FOR SUCH A DEVICE IS TO FIND THE GEOMETRY AND THE NITINOL CONDITIONS OF TEMPERATURE, STRESS, STRAIN, CONDITIONING AND HEAT TREATMENT WHICH WILL ALLOW THE CONVERSION OF THE PHASE TRANSFORMATION INTO A PRESSURE WAVE. AN EXPERIMENTAL AND ANALYTICAL SEARCH IS UNDERWAY FOR THE GEOMETRY AND NITINOL CONDITIONS REQUIRED FOR SOUND AMPLIFICATION BY STIMULATED EMISSION. THE SMOOTH ACCELERATION OF A PROJECTILE BY A SOLID WALL COULD PROVIDE AN ATTRACTIVE ALTERNATE TO J-CROSS-B OR GAS EXPANSION ACCELERATION.

COVALENT ASSOCS INC  
52 DRAGON CT  
WOBURN, MA 01801  
CONTRACT NUMBER:  
DR V R KOCH  
TITLE:  
MICROCRYSTALLITE TITANIUM DISULFIDE CATHODES FOR PULSE  
TOPIC# 5                      OFFICE:

RECHARGEABLE POWER SOURCES POSSESSING HIGH ENERGY DENSITIES, BRIEF BUT REPETITIVE HIGH CURRENT OUTPUTS, AND THOUSANDS OF DUTY CYCLES ARE REQUIRED FOR STRATEGIC DEFENSE SYSTEMS. TO ADDRESS THESE NEEDS, HIGH



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SURFACE AREA, THIN FILM CATHODES ARE BEING FABRICATED FOR AMBIENT TEMPERATURE LITHIUM BATTERIES. THESE CATHODES FEATURE AN ARRAY OF APPROXIMATELY 1 MICROMETER MICROCRYSTALLITE TIS<sub>2</sub> PLATES ORIENTED SUCH THAT THE AXIS OF LITHIUM INTERCALATION IS PERPENDICULAR TO THE PLANE OF THE CURRENT COLLECTOR. RECHARGEABLE CELLS COMPRISING THESE CATHODES AND LI FOIL ANODES ARE BEING ASSEMBLED AND CYCLED UNDER PRESSURE BY A COMPUTER-CONTROLLED BATTERY CYCLER SPECIFICALLY DESIGNED FOR HIGH RATES, LOW CAPACITIES, AND MANY CYCLES. PREPARATION AND COMPLETE CHARACTERIZATION OF THE MICROCRYSTALLITE TIS<sub>2</sub> CATHODES IS UNDERWAY. DUE TO THE SHORT DISCHARGE TIMES (50 TO 100 MSEC) HUNDREDS OF CYCLES ARE BEING ACCUMULATED PER DAY, THEREBY PROVIDING RAPID FEEDBACK IN IDENTIFYING THE CRITICAL VARIABLES AFFECTING PULSE POWER PERFORMANCE. RECHARGEABLE LITHIUM PULSE POWER SYSTEMS COULD FIND IMMEDIATE USE IN MILITARY SATELLITES AND AIRBORNE WEAPONS SYSTEMS. THIS TECHNOLOGY IS ALSO APPLICABLE TO BIO-MEDICAL HARDWARE SUCH AS IMPLANTED DEFIBRILLATORS WHERE HIGH CURRENT PULSES WITH NO VOLTAGE LAG ARE REQUIRED.

CREARE INC  
PO BOX 71 - ETNA RD  
HANOVER, NH 03755  
CONTRACT NUMBER:  
JAVIER A VALENZUELA  
TITLE:  
HIGH PERFORMANCE RADIATOR FOR ADVANCED SPACE POWER SYS  
TOPIC# 7                      OFFICE:

THE LIQUID DROPLET RADIATOR (LDR) IS A LIGHTWEIGHT, HIGH PERFORMANCE HEAT REJECTION CONCEPT FOR SPACE THERMAL MANAGEMENT SYSTEMS. IN THIS CONCEPT, LIQUID DROPLETS ARE PROPELLED THROUGH SPACE AND ARE COOLED BY RADIATION. THE LDR PROMISES AN ORDER OF MAGNITUDE REDUCTION IN RADIATOR WEIGHT (1 KG/M SQUARED) RELATIVE TO ADVANCED HEAT PIPES CURRENTLY UNDER DEVELOPMENT (5-10 KG/M SQUARED); THIS TRANSLATES INTO AS MUCH AS A 25% REDUCTION IN OVERALL POWER SYSTEM WEIGHT FOR FUTURE HIGH POWER MISSIONS. HOWEVER, CURRENT LDR CONCEPTS REQUIRE EXTREMELY ACCURATE AIMING OF DROPLETS TO PREVENT LOSS OF RADIATOR FLUID AND SUBSEQUENT CONTAMINATION OF THE SPACECRAFT. THIS CHALLENGES DEPLOYABILITY AND PRECLUDES OPERATION DURING SPACECRAFT MANEUVERS. THE FEASIBILITY IS BEING INVESTIGATED OF A NOVEL LDR CONCEPT WHICH

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OFFERS THE SAME POTENTIAL FOR AN ORDER OF MAGNITUDE IMPROVEMENT IN HEAT TRANSFER PERFORMANCE BUT ADDITIONALLY PROVIDES POSITIVE CONTROL OF DROPLET TRAJECTORY. HENCE, THE DEVICE CAN BE DESIGNED TO COMPLETELY ELIMINATE FLUID LOSS. THE DEVICE IS ALSO COMPACT, EASILY DEPLOYED, AND IT CAN BE OPERATED DURING SPACECRAFT MANEUVERS. IF PROVEN FEASIBLE, THE CONCEPT WOULD BE DEMONSTRATED AND A PROTOTYPE RADIATOR FOR AN ADVANCED SPACE POWER SYSTEM DESIGNED IN A LATER EFFORT.

CREARE INC  
PO BOX 71 - ENTA RD  
HANOVER, NH 03755  
CONTRACT NUMBER:  
CHRISTOPHER J CROWLEY  
TITLE:  
CRYOCOOLER PULSED CONDUCTORS FOR BUSBARS IN HIGH POWER  
TOPIC# 5 OFFICE:

THE FEASIBILITY IS BEING ASSESSED OF APPLYING CRYOCOOLED CONDUCTOR TECHNOLOGY TO THE BUSBARS OF HIGH CURRENT DENSITY, PULSED POWER SYSTEMS. ALTERNATE CONDUCTOR MATERIALS ARE BEING EVALUATED AND CONDUCTOR GEOMETRY CONCEPTUALIZED. THERMAL TECHNOLOGY FOR RAPID TRANSIENT HEAT TRANSFER IS BEING APPLIED AND KEY EXPERIMENTS ARE BEING CONDUCTED USING EXISTING FACILITIES. AN ANALYSIS IS BEING PERFORMED THAT SYNTHESIZES THIS INFORMATION ON MATERIAL CHARACTERISTICS, GEOMETRIES, AND THERMAL BEHAVIOR IN ORDER TO DETERMINE THE CONDUCTOR WITH THE BEST PERFORMANCE. THE PERFORMANCE SPECIFICATION BEING USED IS THE HIGHEST LIMIT OF STABLE OPERATION OF THE CONDUCTOR UNDER PULSED POWER CONDITIONS (CURRENT DENSITY, PULSE DURATION AND FREQUENCY). SEPARATELY, A SYSTEMS ANALYSIS IS BEING PERFORMED IN ORDER TO EVALUATE THE PRACTICAL BENEFITS OF APPLYING THIS TECHNOLOGY TO BUSBARS IN HIGH POWER SYSTEMS.

CREARE INC  
PO BOX 71 - ETNA RD  
HANOVER, NH 03755  
CONTRACT NUMBER:  
W DODD STACY  
TITLE:  
ULTRARELIABLE CRYOCOOLER FOR SATELLITE SENSOR COOLING  
TOPIC# 3 OFFICE:

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CRYOGENIC COOLERS OF ULTRAHIGH RELIABILITY ARE ESSENTIAL TO THE OPTICAL SENSORS OF A SPACE-BASED BALLISTIC MISSILE DEFENSE SYSTEM. SIMPLICITY, LIGHT WEIGHT, HIGH EFFICIENCY AND LOW COST ARE FURTHER IMPORTANT ATTRIBUTES. THE FEASIBILITY OF A DESIGN AND FABRICATION CONCEPT IS BEING INVESTIGATED THAT ELIMINATES FRICTION, WEAR, AND SEAL LEAKAGE IN STIRLING CYCLE CRYOCOOLERS. DESIGN, FABRICATION, AND ENDURANCE TESTING OF KEY COLD END COMPONENTS CENTRAL TO THE INNOVATIVE CONCEPT ARE BEING PERFORMED. IF SUCCESSFUL, THIS INVESTIGATION WILL DEMONSTRATE THE VIABILITY OF CRITICAL DESIGN ELEMENTS AND FABRICATION TECHNIQUES FOR A LONG LIFE, LOW COST CRYOCOOLER. POTENTIAL COMMERCIAL APPLICATIONS INCLUDE AREAS WHERE LOW POWER ELECTRONIC DEVICES ARE EMPLOYED OR PROPOSED FOR THEIR SENSITIVITY OR SPEED AT CRYOGENIC TEMPERATURES. SOME EXAMPLES ARE: MEDICAL RESEARCH AND DIAGNOSIS, ADVANCED COMPUTERS AND COMMUNICATIONS SYSTEMS (JOSEPHSON JUNCTIONS), AND SATELLITE AND NIGHT VISION SYSTEMS (IR SENSORS).

CRYSTAL SYSTEMS INC  
27 CONGRESS ST  
SALEM, MA 01970  
CONTRACT NUMBER:  
CHANDRA P KHATTAK  
TITLE:

FOUR INCH DIAMETER GaAs CRYSTAL GROWTH USING THE HEAT  
METHOD  
TOPIC# 14

OFFICE:

ONE OF THE SIGNIFICANT ELECTRONIC MATERIALS OF STRATEGIC IMPORTANCE IS SINGLE-CRYSTAL GAAS. GAAS CRYSTALS ARE ESSENTIAL FOR THE NEXT GENERATION OF INTEGRATED CIRCUITS, SUPERCOMPUTERS, AND MICROWAVE DEVICES. CURRENTLY, THREE INCH DIAMETER GAAS CRYSTALS ARE COMMERCIALY AVAILABLE. HOWEVER, THERE IS CONSIDERABLE VARIATION IN PROPERTIES WITHIN A BOULE. THIS VARIATION IN PROPERTIES HAS LIMITED GROWTH OF THE GAAS INDUSTRY FOR LARGE-SCALE MANUFACTURING OF IMPORTANT DEVICES. FOR FUTURE APPLICATIONS, IT IS DESIRABLE TO PRODUCE HIGH QUALITY FOUR INCH DIAMETER GAAS CRYSTALS WITH UNIFORM ELECTRONIC PROPERTIES. A NEW CRYSTAL GROWTH TECHNIQUE, THE HEAT EXCHANGER METHOD (HEM) RECENTLY HAS BEEN ADAPTED FOR THE GROWTH OF GAAS CRYSTALS. IT HAS BEEN SHOWN THAT UNDOPED SEMI-INSULATING TWO AND THREE INCH DIAMETER GAAS CRYSTALS COULD BE GROWN BY HEM WITH REMARKABLY UNIFORM ELECTRONIC PROPERTIES.

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HEM IS BEING USED FOR GROWTH OF UNDOPED GAAS CRYSTALS AND THE  
FEASIBILITY IS BEING SHOWN OF PRODUCING SEMI-INSULATING FOUR INCH  
DIAMETER GAAS WITH UNIFORM PROPERTIES ACROSS THE ENTIRE DIAMETER.

CRYSTALLUME

3180 PORTER DR - STE 2

PALO ALTO, CA 94304

CONTRACT NUMBER:

DR J MICHAEL PINNEO

TITLE:

PLASMA-ENHANCED CHEMICAL VAPOR DEPOSITED DIAMOND THIN

GaAs SUBSTRATES

TOPIC# 14

OFFICE:

THE GROWTH OF POLYCRYSTALLINE DIAMOND THIN FILMS BY ELECTRON-ASSISTED  
PLASMA-ENHANCED CHEMICAL VAPOR DEPOSITION (PE-CVD) OF METHANE RECENTLY  
HAS BEEN DEMONSTRATED TO BE TECHNOLOGICALLY TRACTABLE. HOWEVER, A  
THEORETICAL BASIS FOR THE PHYSICAL AND CHEMICAL PROCESSES THAT GOVERN  
THE SYNTHESIS HAS NOT YET BEEN ESTABLISHED. LACK OF PRECISELY  
CONTROLLED GROWTH PROCESSES FOR APPLICATIONS IN ELECTRONIC DEVICES  
(SUCH AS THOSE BASED ON GAAS) MAY SEVERELY INHIBIT DEVICE RELIABILITY  
AND, THEREFORE, NEGATIVELY IMPACT YIELDS. A SYSTEMATIC MEANS IS BEING  
DEVELOPED TO RELIABLY DEPOSIT ELECTRONIC-QUALITY DIAMOND THIN FILMS ON  
GAAS SUBSTRATES. THE CONDITIONS OF THIN FILM DIAMOND SYNTHESIS BY  
ELECTRON-ASSISTED PE-CVD IS BEING CORRELATED WITH THE RESULTING  
AS-DEPOSITED MICROSTRUCTURE (GRAIN SIZE AND ORIENTATION). VARIABLES  
ARE BEING INVESTIGATED THAT CONTRIBUTE TO CONTROL OF THIS  
MICROSTRUCTURE. CORRELATION BETWEEN MICROSTRUCTURE AND GROWTH  
CONDITIONS IS ENABLING THE DEVELOPMENT OF A PREDICTIVE GROWTH MODEL.  
THE RESEARCH IS FOCUSING ON THE DEVELOPMENT OF A THEORETICAL MODEL FOR  
CONTROLLED THIN FILM GROWTH VIS-A-VIS EXPERIMENTAL DEMONSTRATION AND  
ANALYTICAL VERIFICATION OF RESULTANT FILMS.

CRYSTALLUME

3180 PORTER DR - STE 2

PALO ALTO, CA 94304

CONTRACT NUMBER:

DR J MICHAEL PINNEO

TITLE:

PLASMA-ENHANCED CHEMICAL VAPOR DEPOSITED DIAMOND THIN

TRIBOLOGICAL AND OPTICAL MATERIALS

TOPIC# 13

OFFICE:

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A SYSTEMATIC MEANS IS BEING DEVELOPED TO RELIABLY DEPOSIT OPTICAL-AND/OR TRIBOLOGICAL-QUALITY DIAMOND THIN FILMS ON SUBSTRATES RELEVANT TO STRATEGIC DEFENSE NEEDS. TO ACHIEVE THIS OBJECTIVE, THE CONDITIONS OF THIN FILM DIAMOND SYNTHESIS BY ELECTRON-ASSISTED PLASMA-ENHANCED CHEMICAL VAPOR DEPOSITS ARE BEING CORRELATED WITH THE RESULTING AS-DEPOSITED MICROSTRUCTURE (GRAIN SIZE AND ORIENTATION). CORRELATION BETWEEN MICROSTRUCTURE AND GROWTH CONDITIONS IS ENABLING THE DEVELOPMENT OF A PREDICTIVE GROWTH MODEL. THE RESEARCH IS FOCUSING ON THE DEVELOPMENT OF A THEORETICAL MODEL FOR CONTROLLED THIN FILM GROWTH BY WAY OF EXPERIMENTAL DEMONSTRATION AND ANALYTICAL VERIFICATION OF RESULTANT FILMS. RESULTING APPLICATIONS INCLUDE: LITHOGRAPHY MASKS, IR/UV SENSOR SHIELDS, UV-OPTICS, RADIATION HARD OPTICAL FIBERS, SENSORS FOR HOSTILE ENVIRONMENTS, LASER CAVITY WINDOW, AND SPECTROSCOPE WINDOWS. IN ADDITION, DIAMOND COULD BE USED AS HIGH DAMAGE/HEAT THRESHOLD OPTICAL ELEMENTS, AS HARD OR ABRASION/ABLATION RESISTANT COATINGS ON SENSITIVE OPTICS (E.G., LENSES, MIRRORS, AND RADOMES), OR AS WINDOWS FOR HIGH ENERGY GAS LASER SYSTEMS AND FRAGILE OPTICAL DEVICES SUCH AS HOLOGRAPHIC OPTICAL ELEMENTS.

CSA ENGINEERING INC  
560 SAN ANTONIO RD - STE 101  
PALO ALTO, CA 94306  
CONTRACT NUMBER:  
DR WARREN C GIBSON

TITLE:

AUTOMATED OPTIMIZATION OF STRUCTURES WITH PASSIVE DAMP

ACTIVE CONTROLS

TOPIC# 12

OFFICE:

AUTOMATED OPTIMIZATION, IN CONJUNCTION WITH A FINITE ELEMENT ANALYSIS CODE, IS A POWERFUL TOOL FOR MANY APPLICATIONS. THE OPTIMIZATION CODE WORKS WITH THE FINITE ELEMENT CODE TO MODIFY A DESIGN ACCORDING TO CRITERIA SPECIFIED BY THE USER. IN DESIGN STUDIES, AN OPTIMIZATION CODE COULD BE USED TO IMPROVE THE PERFORMANCE OR EFFICIENCY OF A STRUCTURAL SYSTEM. A STRUCTURAL OPTIMIZATION SOFTWARE TOOL IS BEING DEVELOPED TO ASSIST ENGINEERS IN DESIGNING OPTIMUM STRUCTURES UNDER DYNAMIC ENVIRONMENTAL AND OPERATIONAL LOADS WHEN THE STRUCTURE IS ACTIVELY CONTROLLED. SUCH A DESIGN AND ANALYSIS TOOL ALSO COULD BE USED WHEN AN ACTIVE CONTROL SYSTEM IS NOT PRESENT. A NEW METHOD OF

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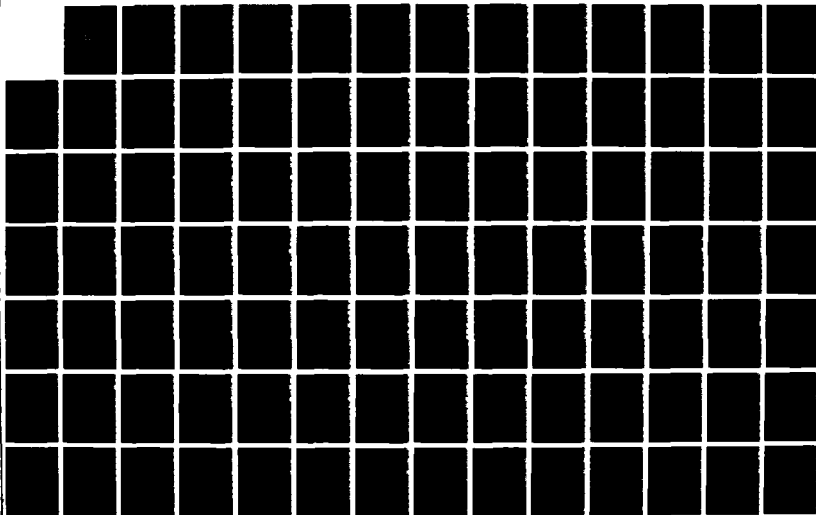
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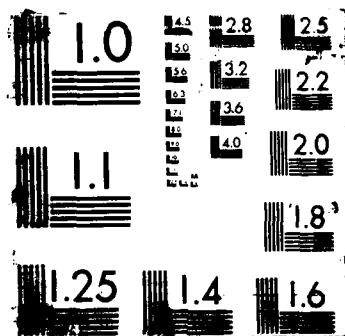
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OPTIMIZING BEAM CROSS-SECTIONS IS BEING DEVELOPED, ONE THAT USES DESIGN VARIABLES THAT DEFINE THE CROSS-SECTION SHAPE, RATHER THAN AREAS AND MOMENTS OF INERTIA. A METHODOLOGY IS BEING DESIGNED TO PERFORM OPTIMIZATION UNDER FREQUENCY DEPENDENT AND TRANSIENT (TIME DEPENDENT) DYNAMIC LOADS. THE METHODOLOGY IS BEING IMPROVED TO PERFORM STRUCTURAL OPTIMIZATION WHEN CONTROL SYSTEMS ARE INCLUDED IN THE SIMULATION. THE OPTIMIZATION SOFTWARE IS BEING PLANNED WITH THE POSSIBILITY OF A FUTURE LINK TO A VISCOELASTIC MATERIALS DATABASE IN MIND SO THAT REALISTIC VISCOELASTIC MATERIALS CAN BE SPECIFIED. THE ARCHITECTURE OF THE CODE AND THE DATABASE CONFIGURATION IS BEING DETERMINED FOR CODE DEVELOPMENT AT A LATER PHASE.

CSA ENGINEERING INC  
560 SAN ANTONIO RD - STE 101  
PALO ALTO, CA 94306  
CONTRACT NUMBER:  
KEVIN E SMITH

TITLE:  
ADMITTANCE MODELING OF SPACE STRUCTURES WITH ACTIVE CO  
TOPIC# 12 OFFICE:

THE METHOD OF ADMITTANCE MODELING IS BEING DEVELOPED FOR ANALYZING COMBINED SPACE STRUCTURES AND CONTROL SYSTEMS. ADMITTANCE MODELING IS USED FOR PREDICTING RESPONSE IN MULTI-COMPONENT LINEAR SYSTEMS. IT USES PHYSICAL-COORDINATE, FREQUENCY-DOMAIN METHODS TO CIRCUMVENT CERTAIN PROBLEMS WHICH OCCUR FREQUENTLY WITH CLASSICAL NORMAL-MODES METHODS. PRIMARY AMONG THESE ARE DIFFICULTIES WITH HIGH-MODAL-DENSITY STRUCTURES AND THE LACK OF RELIABLE DATA AND MODELS WHICH DESCRIBE INPUT EXCITATION. THIS TECHNIQUE HOLDS PROMISE FOR PROVIDING DETAILED AND ACCURATE PREDICTIONS OF VIBRATION LEVELS, SLEWING (TRANSIENT) RESPONSE, AND FIGURE CONTROL OVER THE WIDE FREQUENCY BAND WHICH SPACE-BASED MISSIONS WILL ENCOUNTER. THE METHOD USES MODELING CONCEPTS AND TERMINOLOGY FAMILIAR TO STRUCTURAL ANALYSTS AND CONTROL SYSTEMS ENGINEERS. ADMITTANCE MODELS AND PROCEDURES ARE BEING DEVELOPED FOR ANALYZING COMBINED STRUCTURES/CONTROL SYSTEMS. ANALYTICAL EXPERIMENTS ARE BEING CONSTRUCTED THAT VERIFY THESE MODELS. A PLAN IS BEING DESIGNED FOR INTEGRATING THE RESULTS INTO USABLE SOFTWARE AND FOR PERFORMING A REAL HARDWARE TEST. SUCCESS OF THIS RESEARCH WOULD PROVIDE AN ALTERNATIVE AND POTENTIALLY HIGHLY ACCURATE



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METHOD FOR PREDICTING DYNAMIC BEHAVIOR OF COMBINED STRUCTURES/CONTROL SYSTEMS.

CTI-CRYOGENICS  
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WALTHAM, MA 02254  
CONTRACT NUMBER:  
F WILLIAM PIRTLE III  
TITLE:  
LONG-LIFE HELIUM COMPRESSOR SYSTEM  
TOPIC# 3                      OFFICE:

A LONG-LIFE, HIGH RELIABILITY HELIUM COMPRESSION SYSTEM IS NEEDED FOR CRYOGENIC HELIUM LIQUEFIERS/REFRIGERATORS FOR SPACEBORNE APPLICATIONS. PRESENT STATE-OF-THE-ART COMPRESSION SYSTEMS FOR 4.2K HELIUM LIQUEFIERS REQUIRE OIL LUBRICATION FOR RELIABLE OPERATION. ELIMINATION OF THE NEED FOR OIL LUBRICATION COULD REDUCE THE SIZE AND WEIGHT OF THE SYSTEM AND GREATLY ENHANCE THE RELIABILITY BY ELIMINATING A MAJOR SOURCE OF PROCESS GAS CONTAMINATION. A PROTOTYPE HELIUM COMPRESSION SYSTEM OPERATING WITHOUT OIL LUBRICATION IS BEING ANALYZED, DESIGNED, FABRICATED AND TESTED. THE PRINCIPAL FEATURES OF THE DESIGN ARE LIGHTWEIGHT, HIGH RELIABILITY AND LOW INPUT POWER. THE COMPRESSOR CONCEPT INCLUDES CLEARANCE SEALS, HYDROSTATIC GAS BEARINGS AND LINEAR DRIVE MOTORS. DESIGN VALUES FOR THE CONTAMINATION FREE COMPRESSOR ARE BEING ESTABLISHED AND THERMODYNAMIC TRADE-OFF ANALYSES ARE BEING PERFORMED. MECHANICAL DESIGN CONCEPTS TO DETERMINE THE TECHNICAL FEASIBILITY OF DEVELOPING A LONG-LIFE, MAINTENANCE FREE HELIUM COMPRESSOR SUITABLE FOR SPACEBORNE OPERATION ARE BEING DEVELOPED.

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ALBUQUERQUE, NM 87102  
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DR PATRICK M DHOOGHE  
TITLE:  
ORGANIC PHOTOVOLTAIC MATERIAL  
TOPIC# 5                      OFFICE:

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LIQUID AMMONIA AND OTHER ORGANIC AMINES SOLVATE ALKALI AND ALKALINE EARTH METALS CREATING SOLVATED ELECTRONS. THE SOLUTIONS CAN BE FROZEN AND EXPOSED TO LIGHT WHEREUPON THE COLOR OF THE SOLVATED ELECTRONS FADE. THE FEASIBILITY IS BEING ASSESSED OF FORMING AN ORGANIC SEMICONDUCTOR PHOTOVOLTAIC MATERIAL UTILIZING A LOW MOLECULAR WEIGHT AMPORPHOUS ORGANIC COMPOUND DOPED WITH SOLVATED ALKALI OR ALKALINE EARTH METAL AS THE N-TYPE ELEMENT AND A CORRESPONDING METAL SALT OR FREE RADICAL-CONTAINING AMORPHOUS ORGANIC AS THE P-TYPE ELEMENT. SPECIMENS OF VARIOUS MATERIALS PREPARED BY MELT-QUENCH AND FLASH-EVAPORATION TECHNIQUES ARE BEING TESTED FOR PHOTORESPONSE. THOSE WHICH SHOW PHOTORESPONSE ARE BEING MEASURED FOR PHOTOVOLTAIC EFFICIENCY AND CURRENT VERSUS FREQUENCY (CARRIER MOBILITY) USING AN ALTERNATING POTENTIAL. MEASUREMENTS ARE BEING CONTINUED OVER A PERIOD OF TIME TO DETERMINE HOW STABLE THE MATERIALS ARE. SUCCESSFUL DEVELOPMENT OF AN AMORPHOUS ORGANIC PHOTOVOLTAIC MATERIAL COULD ESTABLISH THE BASIS FOR A NEW CLASS OF INEXPENSIVE PHOTOVOLTAIC MATERIALS. APPLICATIONS INCLUDE SOLAR CELLS, PHOTOCELLS AND OTHER TYPES OF PHOTOELECTRIC DEVICES.

DELTA RESEARCH INC  
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CONTRACT NUMBER:  
DR L B WEINER  
TITLE:  
SENSOR REQUIREMENTS FOR INTERACTIVE DISCRIMINATION  
TOPIC# 3                      OFFICE:

THE PERFORMANCE OF THE STRATEGIC DEFENSE SYSTEM IS PREDICATED ON THE ABILITY TO PERFORM MIDCOURSE DISCRIMINATION. BASED ON THE CAPABILITY OF THE OFFENSE TO MATCH THE REENTRY VEHICLE RADAR AND OPTICAL SIGNATURES WITH DECOYS, ALTERNATIVE DISCRIMINATION TECHNIQUES MUST BE DEVELOPED. THERE HAVE BEEN SEVERAL INTERACTIVE DISCRIMINATION SCHEMES PROPOSED WHEREIN ENERGY IS DEPOSITED ON THE OBJECT (RV OR DECOY), AND RESULTANT OBSERVABLES ARE UTILIZED TO PERFORM THE RV/DECOY SEPARATION. THESE USUALLY DWELL ON THE TECHNOLOGY TO DEPOSIT THE ENERGY ON THE VEHICLE WITHOUT QUANTIFYING THE REQUIREMENTS ON THE VIEWING SENSOR TO MAXIMALLY EXTRACT THE REQUISITE INFORMATION. REQUIREMENTS ARE BEING IDENTIFIED FOR SENSORS TO BE USED IN SUCH AN INTERACTIVE

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DISCRIMINATION SCENARIO. REQUIREMENTS FOR BOTH RADAR AND OPTICAL SENSORS TO RELIABLY DISCRIMINATE BETWEEN A REENTRY VEHICLE AND A PRECISION MATCHED REPLICA DECOY ARE BEING DERIVED FOR SATELLITE, POP-UP PROBE AND FLY-ALONG PROBE SCENARIOS. DETAILED MODELS OF THE PHYSICAL INTERACTION OF THE OBJECT AND OF THE SENSOR OBSERVABLES ARE BEING UTILIZED. GENERALIZED STATISTICAL MEASURES ARE BEING USED TO CHARACTERIZE DISCRIMINATION PERFORMANCE BASED ON THE SENSOR OBSERVABLES. THE FORM OF THE ALGORITHMS REQUIRED TO SUPPORT REAL-TIME DISCRIMINATION BASED ON THE DERIVED SENSOR REQUIREMENTS ARE BEING INCLUDED.

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CONTRACT NUMBER:  
VIRGINIA JOHNSON WOODS  
TITLE:  
AIMPOINT SELECTION ENHANCEMENT DERIVED FROM RESOLUTION  
SPOTS CAUSED BY TARGET TEMPERATURE DIFFERENTIALS  
TOPIC# 3                      OFFICE:

AN INTERCEPTOR WHICH IS HOMING ON RECEIVED ENERGY OVER A LARGE WAVELENGTH BAND MAY STEER TOWARD THE SIGNAL CENTROID. IF THIS SIGNAL CENTROID IS LOCATED BEHIND THE ACTUAL REENTRY VEHICLE (RV), THEN INTERCEPTOR MISS DISTANCE WILL INCREASE. ANALYSIS OF TWO TECHNIQUES IS BEING PROVIDED TO DETERMINE A METHOD FOR RESOLVING THE RV FROM THE ASSOCIATED WAKE SO THAT THE MISS DISTANCE CAUSED BY INFRARED CENTROID UNCERTAINTIES IS MINIMIZED. ONE TECHNIQUE USES THE NATURAL FOCUSING OF THE HOTTER VEHICLE NOSE DUE TO PHYSICAL OPTICS PROPERTIES. A WIDE BAND INFRARED SENSOR IS USED TO DETECT THE BEST AIMPOINT ON AN RV AS IT DESCENDS THROUGH THE ATMOSPHERE. THE DIFFERENCE IN TEMPERATURE BETWEEN THE RV AND ITS WAKE MAY CAUSE A BLUR SPOT INTENSITY DISTRIBUTION WHICH CAN BE USED TO PROVIDE INFORMATION ABOUT THE BEST AIMPOINT LOCATION. ANOTHER TECHNIQUE USES A DIFFRACTION GRATING AS AN INTEGRAL ELEMENT IN THE OPTICS TRAIN TO EXTRACT THE SIGNAL CAUSED BY THE HOT NOSE FROM THE SIGNAL CAUSED BY THE COOLER BASE AND WAKE, IN ORDER TO HOME IN ON THE HOTTER NOSE. REAL TIME SIGNAL EXTRACTION WOULD REQUIRE NO SIGNAL PROCESSING EXCEPT FOR GEOMETRIC CALCULATIONS REQUIRED FOR TRACKING SIGNAL GENERATION.

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315 WYNN DR NW  
HUNTSVILLE, AL 35805  
CONTRACT NUMBER:  
R ALLEN SPENCER  
TITLE:  
OPTICAL HETERODYNE DETECTION FOR ENHANCED EXOATMOSPHER  
DISCRIMINATION PERFORMANCE  
TOPIC# 3                      OFFICE:

CONVENTIONAL, PASSIVE INFRARED DISCRIMINATION TECHNIQUES REQUIRE RADIATION DETECTORS IN SEVERAL, SEPARATE WAVELENGTH BANDS IN ORDER TO ESTIMATE A REMOTE TARGET'S APPARENT TEMPERATURE AND EMISSIVE CHARACTERISTICS. THIS IMPOSES SEVERE OPERATIONAL, CRYOGENIC AND COST PENALTIES FOR THE DISCRIMINATION SENSORS. OPTICAL HETERODYNING, TAKING ADVANTAGE OF RECENT ADVANCES IN STABLE DIODE LASERS, POTENTIALLY COULD REDUCE THESE PENALTIES AND ENHANCE THE PASSIVE MEASUREMENT ACCURACY, THEREBY IMPROVING THE PERFORMANCE OF THE DISCRIMINATION ALGORITHMS. A SYSTEMATIC ANALYSIS IS BEING MADE OF THE OPTICAL HETERODYNE TECHNIQUE FOR THE DISCRIMINATION MISSION. THIS TECHNIQUE MAY POTENTIALLY ALLOW THE DIRECT MEASUREMENT OF THE POWER SPECTRAL DENSITY OF RADIATION FROM A REMOTE TARGET AND, THEREFORE, ALLOW SINGLE DETECTOR WAVEBAND TEMPERATURE DETERMINATION. THE TECHNIQUE WOULD HAVE ADVANTAGES IN TERMS OF SIMPLIFIED SENSOR DESIGNS AND WEIGHT AND COST SAVINGS. FEASIBILITY AND PRACTICALITY OF THE CONCEPT IS BEING DETERMINED. THEORETICAL AND PHYSICAL GROUNDWORK NECESSARY TO EVALUATE THIS PROMISING TECHNIQUE IS BEING DEVELOPED AS IS THE SYSTEM AND COMPONENT LEVEL REQUIREMENTS FOR AN OPTICAL HETERODYNE DISCRIMINATION SENSOR. A PRELIMINARY DESIGN FOR A "PROOF-OF-CONCEPT" DEMONSTRATOR PROTOTYPE USEFUL FOR TESTING AND VALIDATING THE OPTICAL HETERODYNE TECHNIQUES IS BEING PROVIDED.

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CONTRACT NUMBER:  
VIRGINIA JOHNSON WOODS  
TITLE:  
HOMING GUIDANCE LAW IN THE PRESENCE OF A GRAVITATIONAL  
FOR LONG RANGE INTERCEPTORS  
TOPIC# 2                      OFFICE.

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IN LONG-RANGE INTERCEPTS SUCH AS A SPACE-BASED KILL VEHICLE (KV) INTERCEPTION OF A GROUND-BASED BALLISTIC MISSILE IN BOOST PHASE, CURRENT NAVIGATION METHODS ARE LIMITED IN THEIR CAPABILITY TO EFFECT A SMALL MISS DISTANCE WHEN CORRECTING FOR ANTICIPATED ERRORS SUCH AS UNCERTAINTY OF THE ACCELERATION PROFILE OF THE BOOSTER, KV AIM ERROR AND VELOCITY ERROR, TRACKING ERRORS, AND GRAVITATIONAL FIELD ERRORS. THE CONCEPT OF PROPORTIONAL NAVIGATION IS THEORETICALLY AND ANALYTICALLY AN ACCEPTABLE SOLUTION WHICH DOES NOT STRESS COMMUNICATIONS OR WEIGHT REQUIREMENTS. HOWEVER, THE THEORY SEEMS TO COLLAPSE IN LONG-RANGE INTERCEPT CONDITIONS LARGELY DUE TO ASSUMED LINEARITIES IN CLASSICAL PROPORTIONAL NAVIGATION, WHICH WAS DERIVED USING FLAT OR EUCLIDEAN GEOMETRY. AN ATTEMPT IS BEING MADE TO DETERMINE A NEW NON-EUCLIDEAN PROPORTIONAL NAVIGATION LAW FOR THIS TYPE OF NON-EUCLIDEAN, CURVED SPACE LONG-RANGE APPLICATION. THE PROPORTIONAL NAVIGATION LAW IS BEING EXTENDED OR REDERIVED. ASSUMPTIONS APPLICABLE OR NECESSARY IN THIS DERIVATION ARE BEING ESTABLISHED. THE FEASIBILITY OF UTILIZING THIS NEW LAW FOR LONG-RANGE INTERCEPTS IS BEING DETERMINED BY SIMULATION. A NUMBER OF PARAMETERS ARE BEING VARIED TO DETERMINE THE FLEXIBILITY OF THIS APPROACH TO NAVIGATION: VELOCITIES, RANGES, RELATIVE POSITIONS, ACQUISITION RANGE, TIME AT WHICH HOMING DIVERTS ARE CEASED, AND TIME BETWEEN DIVERTS.

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BOULDER, CO 80301  
CONTRACT NUMBER:  
MARK HANDSCHY  
TITLE:  
HIGH PERFORMANCE SPATIAL LIGHT MODULATORS USING FERROE  
LIQUID CRYSTALS  
TOPIC# 11                      OFFICE:

NOVEL, HIGH PERFORMANCE SPATIAL LIGHT MODULATORS (SLM) ARE BEING DEVELOPED FROM ARRAYS OF FERROELECTRIC LIQUID CRYSTAL (FLC) LIGHT VALVES. THE FLC TECHNOLOGY ALLOWS SIMPLE, ECONOMICAL FABRICATION OF SLMS WITH A LARGE NUMBER OF ELEMENTS THAT CAN BE EASILY ADDRESSED EITHER ELECTRONICALLY OR OPTICALLY. PERFORMANCE FEATURES INCLUDE SUBMICROSECOND WRITE TIMES, HIGH OPTICAL THROUGHPUT, HIGH CONTRAST,

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AND EITHER LOW-VOLTAGE, LOW-POWER ELECTRONIC OR OPTICAL ADDRESSING. A HIGH-RESOLUTION 128 X 128 PROOF-OF-CONCEPT SLM IS BEING DEVELOPED. AT A LATER PHASE, HIGHER SPEED SLMs WITH A LARGER NUMBER OF ELEMENTS AND OPTICAL ADDRESSING SCHEMES COULD BE DEVELOPED. IF SUCCESSFUL, THIS PROJECT WILL DEMONSTRATE THE FIRST SIMPLE-TO-FABRICATE, LOW COST, FAST, HIGH CONTRAST, LOW POWER SPATIAL LIGHT MODULATOR. AN SLM WITH THESE PROPERTIES WILL HAVE MYRIAD APPLICATIONS IN OPTICAL SIGNAL PROCESSING AND COMPUTING.

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CHATSWORTH, CA 91311  
CONTRACT NUMBER:  
DR W C HARRIGAN

TITLE:  
THERMAL PULSE SURVIVABLE METALLIC JOINING CONCEPTS FOR  
MATRIX COMPOSITE TRUSS ELEMENTS AND END FITTINGS  
TOPIC# 8                      OFFICE:

GRAPHITE ALUMINUM (GR-AL) AND CERAMIC PARTICULATE REINFORCED ALUMINUM ARE CANDIDATE MATERIALS FOR TUBES AND END FITTINGS, RESPECTIVELY, FOR SPACE STRUCTURES. GR-AL POSSESSES VERY LOW CTE AND VERY HIGH AXIAL THERMAL CONDUCTIVITY, THE LATTER CONTRIBUTING TO INTRINSIC SURVIVABILITY AGAINST HIGH TEMPERATURE THERMAL PULSES. CERAMIC PARTICULATE REINFORCED ALUMINUM HAS BEEN DEMONSTRATED TO HAVE TEMPERATURE RESISTANCE UP TO 1200F. ALTHOUGH METAL MATRIX COMPOSITES POSSESS INTRINSIC SURVIVABILITY, METHODS FOR JOINING TUBES AND END FITTINGS, PRIMARILY ADHESIVE BONDING, LACK THE HARDENING NECESSARY TO PRODUCE TRULY SURVIVABLE SPACE STRUCTURES. ADHESIVE BONDS ARE NOT HIGHLY CONDUCTIVE, OUT GAS, AND LOSE STRUCTURAL INTEGRITY WHEN EXPOSED TO VERY HIGH TEMPERATURES RESULTING IN PERMANENT DEFORMATION OF THE STRUCTURE. METALLIC JOINTS BETWEEN GR-AL AND CERAMIC PARTICULATE REINFORCED ALUMINUM ARE BEING DEMONSTRATED THAT POSSESS LEVELS OF INTRINSIC SURVIVABILITY MUCH HIGHER THAN ACHIEVABLE WITH ADHESIVE BONDED JOINTS. BRAZED DOUBLE LAP SHEAR SAMPLES OF GR-AL AND CERAMIC PARTICULATE REINFORCED ALUMINUM ARE BEING TESTED MECHANICALLY AT ROOM TEMPERATURE AND THERMALLY PULSED USING QUARTZ LAMPS. EFFECTS OF THE PULSE ON SAMPLES UNDER LOAD ARE BEING EVALUATED. BOND QUALITY IS BEING ANALYZED FROM THE TEST DATA AND METALLOGRAPHY. TESTS TO

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DETERMINE THERMAL TRANSFER ACROSS THE BRAZE JOINT ARE BEING PERFORMED  
AND COMPARED TO SIMILARLY TESTED SAMPLES JOINED WITH A SPACE ADHESIVE.

DWA COMPOSITE SPECIALTIES INC

21119 SUPERIOR ST  
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CONTRACT NUMBER:

MICHAEL A WEBB

TITLE:

IMPROVED SYSTEM SURVIVABILITY OF SPACE STRUCTURES USING  
TEMPERATURE RESISTANT HYBRID METAL MATRIX COMPOSITES

TOPIC# 8                      OFFICE:

GRAPHITE-REINFORCED METAL-MATRIX COMPOSITES ARE EXTREMELY ATTRACTIVE  
FOR SPACE STRUCTURES REQUIRING DIMENSIONAL STABILITY, HIGH SPECIFIC  
STIFFNESS, AND NO OUTGASSING. THEY ALSO PROMISE LARGE-SYSTEM  
SURVIVABILITY IMPROVEMENTS DUE TO THEIR VERY HIGH HEAT-DISSIPATION  
CAPABILITY AND GOOD, HIGH-TEMPERATURE RESISTANCE. KEY AREAS FOR MAJOR  
IMPROVEMENT IN G/METAL STRUCTURES' SURVIVABILITY ARE: USE OF  
HIGH-YIELD-STRENGTH MATRIX WHICH REQUIRES NO HEAT TREATMENT TO  
ELIMINATE HYSTERESIS IN THERMAL EXPANSION; AND DISCONTINUOUS  
REINFORCEMENT OF THE MATRIX PROVIDING RETENTION OF STRUCTURAL AND  
DIMENSIONAL INTEGRITY DURING AND AFTER A VERY HIGH-TEMPERATURE THERMAL  
PULSE. THE EFFECTIVENESS IS BEING DETERMINED OF ULTRA-FINE CERAMIC OR  
INTERMETALLIC PARTICULATE REINFORCEMENT OF GRAPHITE/METAL COMPOSITES  
FOR AN IMPROVED SURVIVABLE SPACE STRUCTURE WHICH RETAINS DIMENSIONAL  
STABILITY DURING AND AFTER EXTREME THERMAL-PULSE EXPOSURE. SUCCESSFUL  
RESULTS ARE EXPECTED BECAUSE CERAMIC PARTICULATE-REINFORCED ALUMINUM  
AND MAGNESIUM ALLOYS EXHIBIT YIELD STRENGTHS ABOVE THE NECESSARY 40  
KSI SHOWN TO ELIMINATE COEFFICIENT OF THERMAL EXPANSION HYSTERESIS AND  
RETAIN THEIR SHAPE AFTER HOURS OF EXPOSURE TO TEMPERATURES ALMOST  
TWICE THE MATRIX MELTING POINT. THESE UNIQUE CAPABILITIES ARE BEING  
TRANSLATED TO THE MATRIX IN G/METAL SPACE STRUCTURAL MATERIALS.

DWA COMPOSITE SPECIALTIES INC

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CONTRACT NUMBER:

TIMOTHY A LOFTIN

TITLE:

HIGH TEMPERATURE CAPABLE GRAPHITE-METAL SPACE STRUCTUR  
IMPROVED PASSIVE DAMPING CAPABILITY AND FATIGUE RESIST

TOPIC# 13                      OFFICE:

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GRAPHITE-REINFORCED METAL-MATRIX COMPOSITES ARE EXTREMELY ATTRACTIVE FOR SPACE STRUCTURES REQUIRING DIMENSIONAL STABILITY, HIGH SPECIFIC STIFFNESS, AND NO OUTGASSING. THEY ALSO PROMISE IMPRESSIVE SYSTEM SURVIVABILITY IMPROVEMENTS DUE TO THEIR VERY HIGH HEAT-DISSIPATION CAPABILITY AND GOOD HIGH-TEMPERATURE RESISTANCE. KEY AREAS FOR MAJOR IMPROVEMENT IN PERFORMANCE CAPABILITY ARE: IMPROVED RESISTANCE TO VERY HIGH TEMPERATURES; GREATLY IMPROVED PASSIVE VIBRATIONAL DAMPING CAPACITY; AND IMPROVED FATIGUE RESISTANCE. DISCONTINUOUS REINFORCEMENT OF THE MATRIX COULD HAVE A MAJOR IMPACT ON TEMPERATURE AND FATIGUE PERFORMANCE; WHILE USE OF A HIGH-DAMPING MAGNESIUM MATRIX TOGETHER WITH TITANIUM FOIL-CLADDING COULD GREATLY INCREASE COMPOSITE DAMPING CAPACITY. INCREASES IN TEMPERATURE, FATIGUE AND DAMPING CAPABILITY OF THIN-PLY GRAPHITE MAGNESIUM COMPOSITES ARE BEING EXAMINED USING HIGH-DAMPING MATRIX ALLOYS REINFORCED WITH FINE DISCONTINUOUS PARTICULATE AND CLAD WITH EITHER REINFORCED MAGNESIUM FOILS OR THIN TITANIUM FOILS. THE FEASIBILITY IS BEING DEMONSTRATED OF AN ADVANCED/HIGH-DAMPING METAL-MATRIX COMPOSITE STRUCTURAL MATERIAL, WHICH ALSO WITHSTANDS TEMPERATURES WELL ABOVE THE MATRIX MELTING POINT WITHOUT SIGNIFICANT DISTORTION OR MATRIX FLOW, MAINTAINS FULL DIMENSIONAL STABILITY AFTER HIGH TEMPERATURE EXPOSURE, AND HAS IMPROVED FATIGUE RESISTANCE BY VIRTUE OF A STRONGER MATRIX AND SURFACE CLADDINGS.

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21311 HAWTHORNE BLVD - STE 300  
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CONTRACT NUMBER:  
C MICHAEL DUBE  
TITLE:  
COMPOSITE EMBEDDED FIBER OPTIC SENSORS FOR ACTIVE CONT  
OF SPACE STRUCTURES  
TOPIC# 12                      OFFICE:

AN ACTIVE STRUCTURAL VIBRATION CONTROL SYSTEM IS BEING DEVELOPED FOR STRATEGIC DEFENSE ORBITAL PLATFORMS. THIS SYSTEM IS EMPLOYING FIBER OPTIC SENSORS EMBEDDED IN COMPOSITE LAMINATED STRUCTURAL ELEMENTS TO ACHIEVE A RUGGED INTEGRATED SENSOR AND CONTROL SYSTEM RESULTING IN HIGH MANEUVERABILITY AND POINTING STABILITY. THIS CONCEPT OFFERS PARTICULAR ADVANTAGES IN TERMS OF DISTRIBUTED SENSOR PLACEMENT,



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GEOMETRY, AND SIGNAL PROCESSING CAPABILITIES. AN ANALYTICAL AND EXPERIMENTAL ASSESSMENT IS BEING PERFORMED TO: SELECT CANDIDATE CONTROL ALGORITHMS; IDENTIFY SENSOR AND SIGNAL PROCESSING REQUIREMENTS; DEMONSTRATE THE FEASIBILITY OF EMBEDDED OPTICAL SENSORS; AND ESTABLISH PROTOTYPE REQUIREMENTS FOR LATER DEVELOPMENT. TESTS OF PROTOTYPE COMPOSITE STRUCTURES WITH EMBEDDED SENSORS IS EXPECTED TO PROVIDE KEY BENCHMARK RESULTS FOR ADVANCED SYSTEM DEVELOPMENT. BEYOND THE IMMEDIATE NEED FOR STRATEGIC DEFENSE PLATFORMS, THIS RESEARCH WOULD BE DIRECTLY APPLICABLE TO OTHER SPACE STRUCTURES AS WELL AS TO LARGE TERRESTRIAL STRUCTURES SUCH AS OCEAN PLATFORMS.

E-TEK DYNAMICS INC  
250 EAST DR  
MELBOURNE, FL 32904  
CONTRACT NUMBER:

J J PAN

TITLE:

OPTICAL MULTIPLE TARGET SURVEILLANCE POINTING ACQUISIT  
AND TRACKING SENSORS  
TOPIC# 3                      OFFICE:

FOR THE SPACE-BASED STRATEGIC DEFENSE SYSTEM, CONVENTIONAL OPTICAL BEAM POINTING/STEERING/TRACKING SYSTEM USING MECHANICAL GIMBALS HAS NUMEROUS SHORTCOMINGS SUCH AS HEAVY WEIGHT, HIGH PROBABILITY OF ERRORS, LONG ACQUISITION TIME, AND LARGE FRICTIONAL AND BEARING NOISE. THE CONVENTIONAL MECHANICAL SERVO CANNOT TRACK MULTIPLE TARGETS SIMULTANEOUSLY AND CANNOT PERFORM WIDE ANGLE SURVEILLANCE DUE TO LIMITED BANDWIDTH OF SERVO LOOPS. TO REDUCE OR ELIMINATE THESE SHORTCOMINGS, A WIDE VIEW, FAST STEERING OPTICAL SURVEILLANCE, POINTING, ACQUISITION, AND TRACKING SENSOR FOR MULTIPLE TARGETS IS REQUIRED. TO ADDRESS THIS NEED, MULTIAPERTURE COMPOUND EYE CONFIGURATIONS AND ADAPTIVE OPTICAL MULTIBEAM PHASED STEERING ARRAYS FOR MULTIPLE TARGETS SURVEILLANCE, POINTING, ACQUISITION, AND TRACKING ARE BEING INVESTIGATED, ANALYZED AND COMPARED AGAINST DERIVED DESIGN PARAMETERS. BOTH APPROACHES HAVE ADVANTAGES OF MORE THAN HEMISPHERIC COVERAGE AND MULTITARGET HANDLING CAPABILITY. HARDWARE FABRICATION TECHNOLOGIES ARE AVAILABLE BY USING FIBER OPTICS, INTEGRATED OPTICS, OPTO-ELECTRONICS, AND HIGHLY SENSITIVE OPTIC DETECTION. FOR EXAMPLE, LINBO3 OR GAAS INTEGRATED PHASE SHIFTERS CAN BE USED TO STEER THE

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MULTIPLE OPTICAL BEAMS. LOW NOISE MESFETS SERVE AS VERY SENSITIVE PHOTODETECTORS TO DESIGN THE ALMOST QUANTUM NOISE LIMITED DETECTION SYSTEMS.

ECODYNAMICS RESEARCH ASSOCS INC  
PO BOX 8172  
ALBUQUERQUE, NM 87198  
CONTRACT NUMBER:  
DR PATRICK J ROACHE  
TITLE:  
SHORT WAVELENGTH CHEMICAL LASERS  
TOPIC# 1                      OFFICE:

A COMPUTER MODEL CAPABLE OF REALISTICALLY ADDRESSING THE CHEMICAL AND FLUID PROCESSES IN SHORT WAVELENGTH CHEMICAL LASERS PRESENTLY DOES NOT EXIST. AN EXISTING TIME-DEPENDENT, MULTI-SPECIES, CHEMICALLY REACTING, NAVIER-STOKES COMPUTER MODEL, THE RAVEN CODE, IS BEING EXTENDED TO MODEL THE COMPLEX MULTI-PHASE (LIQUID-GAS) PROCESSES IN SHORT WAVELENGTH CHEMICAL LASERS (SWCL). THIS STUDY IS FORMULATING THE THEORETICAL EQUATIONS NECESSARY FOR ANALYZING THE LIQUID PENETRATION/BREAKUP, DROPLET HEATING AND VAPORIZATION, MIXING AND KINETICS IN SWCL SYSTEMS FOR THE NEXT EXTENSION OF RAVEN. THE WORK INVOLVES EVALUATION OF ADVANCED MULTI-PHASE SOLUTION ALGORITHMS FOR INCORPORATION INTO THE RESTRUCTURED RAVEN. THIS COMPUTER MODEL HAS CONSIDERABLE POTENTIAL FOR IMPROVING OUR UNDERSTANDING OF THE LASER PHYSICS OF SHORT WAVELENGTH CHEMICAL LASERS. APPLICATION OF THE COMPUTER MODEL WILL INCLUDE RESEARCH IN BASIC MULTI-PHASE FLUID PHYSICS AND COMPUTATIONAL FLUID DYNAMICS AND PROJECTS IN LASER PHYSICS, HYPERSONIC COMBUSTION AND ENERGY SYSTEMS.

ELECTRIC PROPULSION LAB INC  
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TEHECHAPI, CA 93561  
CONTRACT NUMBER:  
DR GRAEME ASTON  
TITLE:  
PLASMA CONTAINMENT SCHEME FOR HIGH THRUST DENSITY ION  
TOPIC# 6                      OFFICE:

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PRESENT ION ENGINE TECHNOLOGY IS LIMITED IN ENGINE THRUST DENSITY AND EFFICIENCY BY ENERGY EXPENSIVE PLASMA PRODUCTION PROCESSES AND BY ION ACCELERATOR SYSTEM DESIGNS WHICH LIMIT THE ATTAINABLE BEAM CURRENT DENSITY. IN ADDITION, NO EFFORTS HAVE BEEN MADE TO ENHANCE THE BASIC LOW OPERATING TEMPERATURE POTENTIAL OF THE ENGINE CONCEPT TO CREATE AN ENGINE DESIGN WITH LITTLE OR NO INFRARED SIGNATURE. CONVENTIONAL ION ENGINE ACCELERATOR SYSTEMS CANNOT PROVIDE BOTH HIGH BEAM CURRENTS AND HIGH BEAM ENERGY AND A NEW APPROACH IS REQUIRED. PROOF-OF-PRINCIPLE TESTS ARE BEING PERFORMED ON A LOW LOSS PLASMA CONTAINMENT CONCEPT THAT MAY BE SUITABLE FOR HIGH EFFICIENCY DISCHARGE CHAMBER OPERATION IN A 50 KW ELECTRIC PROPULSION ENGINE BASED ON THE ELECTROSTATIC ION ACCELERATION PROCESS. THIS PLASMA CONTAINMENT CONCEPT IS NOT ANTICIPATED TO BE SUBJECT TO THE NORMAL ION AND ELECTRON LOSS CHARACTERISTICS. ION FLUX LEVELS CAPABLE OF SUPPORTING UP TO A 50 AMPERE ION BEAM ARE BEING ESTABLISHED USING THIS PLASMA CONTAINMENT SCHEME FOR TEST PERIODS OF UP TO SEVERAL HOURS. AN ION ACCELERATOR SYSTEM CAPABLE OF PROVIDING HIGH THRUST DENSITY AND HIGH SPECIFIC IMPULSE IS BEING DESIGNED TO MATE TO THIS DISCHARGE CHAMBER. THIS ACCELERATOR SYSTEM INCORPORATES DESIGN FEATURES WHICH ARE EXPECTED TO ELIMINATE ELECTRODE GAP CHANGES UNDER HIGH BEAM POWER CONDITIONS.

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PHILADELPHIA, PA 19107  
CONTRACT NUMBER:  
NORBERT B ELSNER

TITLE:

SILICON-GERMANIUM ALLOYS CONTAINING ADDITIONS TO LOWER  
CONDUCTIVITY

TOPIC# 4

OFFICE:

SMALL AMOUNTS OF CERTAIN ADDITIVES HAVE BEEN ADDED TO SILICON-GERMANIUM (SIGE) BASED ALLOYS WITH A SIGNIFICANT DROP IN THERMAL CONDUCTIVITY AND CORRESPONDING IMPROVEMENT IN THE FIGURE OF MERIT (A FACTOR OF TWO IMPROVEMENT AT 300C). THESE ADDITIONS TO SIGE BASED ALLOYS ARE EXPECTED TO IMPROVE SIGNIFICANTLY THE CONVERSION EFFICIENCY OF THERMOELECTRIC GENERATORS. VERIFICATION OF THIS IMPROVEMENT IS BEING INVESTIGATED VIA THE SYNTHESIS AND CHARACTERIZATION OF THESE REPORTED PROMISING COMPOSITIONS. THEIR

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THERMOELECTRIC PROPERTIES ARE BEING OBTAINED AS A FUNCTION OF TEMPERATURE WHICH HAS BEEN LIMITED TO APPROXIMATELY 700C. THE REDUCTION IN THERMAL CONDUCTIVITY WITH THESE SAME ADDITIVES IS BEING DETERMINED WITH THE WIDELY USED POWDER METALLURGY PREPARED SI22GE ALLOY (BOTH WITH AND WITHOUT GAP). THE SI22GE ALLOY IS BEING DEVELOPED FOR THE THERMOELECTRIC CONVERTER OF THE SPACE-BASED POWER SUPPLY.

ELECTRO-OPTEK CORP  
3152 KASHIWA ST  
TORRANCE, CA 90505  
CONTRACT NUMBER:  
WILLIAM S CHAN  
TITLE:  
HARDENED ELECTRONICS FOR CRYOGENIC TEMPERATURES  
TOPIC# 14                      OFFICE:

MANY MICROELECTRONIC CIRCUITS USED IN DEFENSE SYSTEMS ARE REQUIRED TO OPERATE AT CRYOGENIC TEMPERATURES AND BE RADIATION HARD AT THE SAME TIME. A NEW TECHNOLOGY IS BEING DEVELOPED FOR GE JUNCTION-FIELD-EFFECT TRANSISTOR (JFET) CIRCUITS. IT IS BASED ON MOLECULAR BEAM EPITAXY (MBE) OF GE ON A STRAINED SUPERLATTICE OF GE SI, ALSO GROWN BY MBE ON AN ORDINARY SI SUBSTRATE. THE STRAINED SUPERLATTICE ACTS AS A PERFECTLY LATTICE-MATCHED BUFFER TO ENSURE A HIGH DEGREE OF EPITAXY OF GE. THE RESULTANT GE JFET DEVICES ARE ANTICIPATED TO BE OPERATED AT A TEMPERATURE BELOW 10K AND CAPABLE OF EXTREMELY LOW NOISE AND HIGH RADIATION HARDNESS, TWO HIGHLY DESIRABLE CHARACTERISTICS FOR SPACEBORNE ELECTRONICS FOR INFRARED (IR) SENSORS IN THE LONG WAVELENGTH IR (LWIR) SPECTRAL REGION. THE LOW TEMPERATURE MODEL FOR GE JFET IS BEING ESTABLISHED AND THE MBE PROCESSES AND REQUIREMENTS ARE BEING DEFINED TO FABRICATE THE MULTIEPILAYERED STRUCTURE. SUCCESS OF THIS PROGRAM WOULD HAVE WIDE APPLICATIONS IN FUTURE SPACEBORNE SURVEILLANCE MISSIONS REQUIRING RADIATION-HARD, AND LOW NOISE MICROCIRCUITS TO OPERATE HIGH-SENSITIVITY LWIR SENSORS OPERATING AT CRYOGENIC TEMPERATURES.

EMEC CONSULTANTS  
RD 3 - ROUNDTOP RD  
EXPORT, PA 15632  
CONTRACT NUMBER:  
DR RUDOLF KELLER  
TITLE:  
ALUMINUM-CARBON COMPOSITE MATERIALS  
TOPIC# 13                      OFFICE:

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IMPROVED METAL-MATRIX/CARBON COMPOSITE MATERIALS MAY YIELD SOME OF THE PROPERTIES THAT ARE REQUIRED FOR THE DESIGN AND CONSTRUCTION OF SPACE STRUCTURES, SUCH AS LOW COEFFICIENTS OF THERMAL EXPANSION. THE FEASIBILITY IS BEING INVESTIGATED OF A SIMPLIFIED FABRICATION TECHNIQUE FOR ALUMINUM-CARBON COMPOSITE MATERIALS BY PRECIPITATING A TITANIUM DIBORIDE COATING ONTO THE CARBON. THE EFFORT IS FOCUSING ON A SIMPLIFIED TREATMENT OF THE REINFORCING COMPONENT AND THE INTERACTIONS OF THE PHASES AT THE INTERFACE. IN PARTICULAR, THE DISTRIBUTION OF THE PRECIPITATED TITANIUM DIBORIDE AND THE RESULTING INTERFACIAL CHARACTERISTICS BETWEEN CARBON AND SOLIDIFIED ALUMINUM AS THEY RELATE TO DESIRABLE MATERIALS PROPERTIES ARE BEING EXAMINED.

ENERGY COMPRESSION RESEARCH CORP  
1110 CAMINO DEL MAR - STE C  
DEL MAR, CA 92014  
CONTRACT NUMBER:  
OVED ZUCKER  
TITLE:  
SUBNANOSECOND LOW IMPEDANCE PUMPED X-RAY LASER CONCEPT  
TOPIC# 1                      OFFICE:

PRESENT DISCHARGE PUMPED CAPILLARY EXPERIMENTS UTILIZE THE EXISTING MARX/PFL TECHNOLOGY WHICH HAVE RISE TIMES OF APPROXIMATELY 10 NANOSECONDS (NS). THIS TIME IS AN ORDER OF MAGNITUDE TOO SLOW WHEN COMPARED TO THE CAPILLARY'S TIME SCALE. AN APPROACH IS BEING DEVELOPED FOR PRODUCING A SUB-NS RISE DISCHARGE IN A CAPILLARY WHICH WILL PROVIDE THE PUMP ENERGY FOR AN X-RAY LASER. A TABLE TOP EXPERIMENT IS BEING USED WHICH UTILIZES A CHARGED, HIGH ENERGY DENSITY DIELECTRIC FILM CLOSELY COUPLED TO THE CAPILLARY VIA A LIGHT ACTIVATED SEMICONDUCTOR SWITCH. THE MODELING SHOWS THAT THIS METHOD PROVIDES ADEQUATE ENERGY AND POWER DENSITY TO THE ACTIVE CAPILLARY VOLUME FOR X-RAY LASER EXPERIMENTS. THE SALIENT FEATURES OF THIS APPROACH INCLUDE LOW COST, FAST TURN AROUND TIME, RELATIVELY CLEAN DIAGNOSTICS, AND EASY SCALEUP IN POWER, ENERGY, AND IMPEDANCE. DEVELOPMENT OF THIS TECHNOLOGY WILL PROVIDE EXTREMELY COMPACT X-RAY LASERS FOR DEFENSE APPLICATIONS AND WILL PRODUCE A MAJOR IMPACT IN THE MEDICAL FIELD AS WELL AS IN THE X-RAY LITHOGRAPHY FIELD FOR VHSIC-TYPE APPLICATIONS.

ENERGY COMPRESSION RESEARCH CORP  
1110 CAMINO DEL MAR - STE C  
DEL MAR, CA 92014  
CONTRACT NUMBER:  
OVED ZUCKER  
TITLE:  
COMPACT SOLID DIELECTRIC LIGHT ACTIVATED SEMICONDUCTOR  
ACTIVATED MEGAVOLT PULSER  
TOPIC# 5                      OFFICE:

SUBMITTED BY  
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THE IMPETUS FOR BUILDING PULSE FORMING LINE SYSTEMS WITH DIELECTRIC FILMS COMES FROM THE RECOGNITION THAT CAPACITORS HAVE BEEN SUCCESSFUL IN SERIESING FILMS WITH MINIMAL AVERAGE FIELD DERATING UP TO ABOUT 50 KV; AND THAT SINGLE STRIPLINES HAVE DEMONSTRATED FAST (NANO-SECOND) DISCHARGES. THUS, IN PRINCIPLE, IT SHOULD BE POSSIBLE TO BUILD A MEGAVOLT, DC-CHARGED STACK OF FILM WHICH CAN BE DISCHARGED AS A STRIPLINE. THIS WOULD REPLACE THE ENTIRE POWER TRAIN FROM MARX TO VACUUM INTERFACE WITH A MOST COMPACT MEDIUM. SUCH A MEGAVOLT DIELECTRIC FILM SYSTEM SHOULD HAVE A POSITIVE VOLTAGE GRADING SCHEME AND USE EITHER NARROW FILMS OR WIDE DISTRIBUTED SWITCHES. THE FEASIBILITY IS BEING EVALUATED OF SUCH A CONCEPT FOR THE PRODUCTION OF HIGHLY COMPACT MEGAVOLT PULSERS FOR HIGH POWER MICROWAVE AND DIRECTED ENERGY APPLICATIONS. INTEGRATION OF LIGHT ACTIVATED SEMICONDUCTOR SWITCHES WITH ENERGY STORAGE FILM IN STACKED BLUMLEINS AND RELATED CONFIGURATIONS IS INVOLVED. THE INTEGRATION OF THE SWITCHES WITH THE CONFIGURATIONS ALLOWS FOR PRECISE TRANSIENT CONTROL. THIS IS CRUCIAL FOR MEGAVOLT, SOLID DIELECTRIC FILM SYSTEMS. THE RESULTING CONFIGURATION ALLOWS FOR OVERALL MEGAVOLT PULSER DENSITY BELOW 100 LITERS. THIS INCLUDES THE LASER (DIODE PUMPED YAG) AND ASSOCIATED POWER CONDITIONING.

ENERGY CONVERSION DEVICES INC  
1675 W MAPLE RD  
TROY, MI 48084  
CONTRACT NUMBER:  
DR WALLY CZUBATYJ  
TITLE:  
THIN FILM OPTICAL DIRECTIONAL COUPLER  
TOPIC# 11                      OFFICE:

INTEGRATED OPTICAL COMMUNICATION WILL ALLOW THE FABRICATION OF FASTER AND HIGHER DENSITY VLSI CIRCUITS. THE FABRICATION OF A DEPOSITED THIN FILM OPTICAL LINK ALLOWS COMPLEX MULTILAYER OPTICAL INTERCONNECTION OF CIRCUITS AND DEVICES AFTER WAFER FABRICATION BECAUSE OF LOW TEMPERATURE PROCESSING. THE THIN FILM OPTICAL DIRECTIONAL COUPLER IS A KEY COMPONENT FOR OPTICAL INTEGRATION. ITS FUNCTION IS TO EFFICIENTLY TURN AND CONCENTRATE LIGHT AT A 90 DEGREE ANGLE. A DEVICE IS BEING DESIGNED AND FABRICATED THAT WILL RE-DIRECT LIGHT IN A DIRECTION NORMAL TO AN EMITTING SURFACE. A THIN FILM PLASMA PROCESSED

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DEVICE IS BEING FABRICATED THAT WILL DEMONSTRATE THE RE-DIRECTION OF LIGHT FROM THE VERTICAL TO THE HORIZONTAL. THIS IS A NECESSARY COMPONENT IN FORMING A SYSTEM FOR PLANAR INTRA OR INTERCHIP OPTICAL COMMUNICATION. SUCH AN OPTICAL DIRECTIONAL COUPLER HAS INHERENT ADVANTAGES, I.E., A THIN LARGE AREA DEPOSITED FILM (LOW-COST) PROCESSED AT LOW TEMPERATURE (ADD-ON TO VLSI).

ENERGY MATERIALS RESEARCH CO  
2398 4TH ST  
BERKELEY, CA 94710  
CONTRACT NUMBER:  
JOHN BROOKES  
TITLE:  
PARALLEL CONNECTION MACHINE FOR NEURAL NETWORK COMPUTI  
TOPIC# 11                      OFFICE:

SOFTWARE AND HARDWARE MODELLING IS BEING CONDUCTED FOR A NEURAL NETWORK PATTERN RECOGNITION DEVICE. THE CURRENT SOFTWARE DEVELOPMENT ENVIRONMENT AUTOMATICALLY RUNS FEATURE EXTRACTION TESTS ON TWO-DIMENSIONAL PATTERNS. A NEURAL NETWORK MODEL WITH BACK ERROR PROPAGATION WILL BE DESIGNED AND MODELLED USING NEURAL NET SOFTWARE. THE NEURAL NETWORKS WILL BE INITIALLY DESIGNED TO COORDINATE MULTIPLE FEATURE EXTRACTION TESTS TO ARRIVE AT A FUZZY CLASSIFICATION DECISION. BASED ON THIS MODELLING, A HARDWARE DESIGN WILL BE EXECUTED AND PARTIALLY MODELLED USING COMPONENTS.

ENERGY SCIENCE LABS INC  
PO BOX 85608  
SAN DIEGO, CA 92138  
CONTRACT NUMBER:  
TIMOTHY R KNOWLES  
TITLE:  
GRAPHITE/PHASE-CHANGE-MATERIAL THERMAL STORAGE COMPOST  
TOPIC# 7                      OFFICE:

THERMAL MANAGEMENT OF FLUCTUATING POWER IN SPACECRAFT IS AIDED BY THE USE OF SUITABLY PLACED THERMAL ENERGY STORAGE (TES), WHICH OFTEN USES LATENT HEAT OF PHASE-CHANGE MATERIALS (PCMS) FOR THE STORAGE MEDIUM.

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AN OUTSTANDING PROBLEM WITH TES IS HOW TO GET THE THERMAL RESPONSE FAST ENOUGH TO ACCOMMODATE PULSE-POWER SITUATIONS. TO ADDRESS THIS NEED, THE FEASIBILITY IS BEING DEMONSTRATED OF HIGH-FLUX TES BASED ON GRAPHITE/PHASE-CHANGE MATERIAL COMPOSITES. THE EXTRAORDINARILY HIGH THERMAL CONDUCTIVITY OF CERTAIN FORMS OF GRAPHITE IS JOINED WITH THE HIGH EFFECTIVE HEAT CAPACITY (NEAR THE TRANSITION TEMPERATURE) OF PCMS TO PRODUCE NOVEL MATERIALS HAVING UNSURPASSED SPEEDS OF CONDUCTIVE HEAT ABSORPTION AND HEAT RELEASE. THE APPROACH, BASED ON THE NEWLY DEVELOPED METAL/PCM COMPOSITE TECHNOLOGY, INDICATES THAT HIGHEST PERFORMANCE IS ACHIEVED WITH HIGHLY DISPERSED 50-50 COMPOSITES. MATERIALS BEING INVESTIGATED INCLUDE SELECTED HIGH-THERMAL-CONDUCTIVITY TYPES OF CARBON FIBERS AND EXFOLIATED GRAPHITE. THERMAL PERFORMANCE TESTS ON GRAPHITE/PCM COMPOSITES ARE BEING PERFORMED AT BOTH AMBIENT AND ELEVATED TEMPERATURES. RESULTS ARE BEING ANALYZED IN TERMS OF THE HOMOGENEOUS MODELS USED IN METAL/PCM STUDIES. METHODS OF ACHIEVING A HIGH-HEAT-TRANSFER INTERFACE BETWEEN THE VOLUME OF THE TES COMPOSITE AND HEAT SOURCES ARE BEING INVESTIGATED.

ERG INC (NEW: AKER INDUSTRIES)  
952 57TH ST  
OAKLAND, CA 94608  
CONTRACT NUMBER:  
G M BENSON

TITLE:  
NET SHAPE CERAMIC COMPOSITES FOR HIGH TEMPERATURE APPL  
TOPIC# 13                      OFFICE:

TO BE COST EFFECTIVE FOR STRATEGIC DEFENSE APPLICATIONS, MATERIALS EXHIBITING LIGHTWEIGHT, HIGH STRENGTH, DIMENSIONAL STABILITY AND HIGH TEMPERATURE CAPABILITY MUST BE CERAMIC AND BE EASILY FORMED TO NET SHAPE WITHOUT REQUIRING GRINDING TO FINAL CONFIGURATION. A PROCESS IS BEING DEMONSTRATED OF FORMING AND JOINING AN INTEGRAL HIGH STRENGTH CERAMIC FOAM CORE TO A SMOOTH-SURFACED SKIN (FILAMENT OR WHISKER REINFORCED AS NECESSARY) SO AS TO FORM NET SHAPE FINAL COMPONENTS WITH SMOOTH SURFACES. THE PHYSICAL PROPERTIES OF THESE COMPOSITES ARE BEING DETERMINED THROUGH TESTING OF SAMPLE SPECIMENS BY INDEPENDENT LABORATORIES. THE CERAMIC COMPOSITES BEING FABRICATED AND TESTED COMPRISE A CELLULAR FOAM CORE OF HIGH STRENGTH SN OR SC LIGAMENTS THAT



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IS SKINNED WITH A HIGH STRENGTH SN OR SC IMPERVIOUS SMOOTH SURFACE WITH OR WITHOUT FILAMENT REINFORCEMENT. TENSILE STRENGTHS OF SC FILAMENTS/LIGAMENTS HAVE REACHED 700 KPSI WITH TENSILE MODULI OF 70 MPSI. THE RESULTING SKINNED-CORE COMPOSITE SHOULD EXHIBIT HIGH STRENGTH AND STIFFNESS, LOW WEIGHT, HIGH TEMPERATURE CREEP AND OXIDATION RESISTANCE, LOW THERMAL EXPANSION AND EXCELLENT DIMENSIONAL STABILITY. THE SUCCESSFUL DEVELOPMENT OF THE CERAMIC COMPOSITES WOULD HAVE POTENTIAL APPLICATION IN GAS TURBINE BLADES, NOZZLES AND COMBUSTORS; ADIABATIC DIESEL PISTONS, CYLINDER LINERS, HEADS AND VALVES; STIRLING ENGINE HOT COMPONENTS; AND LASER MIRRORS.

ERG SYSTEMS

BRACKENWOOD PATH - HEAD OF THE HARBOR

ST JAMES, NY 11780

CONTRACT NUMBER:

DR JOHN L REMO

TITLE:

LONG TRACE PROFILER FOR METROLOGY OF LARGE OPTICS

TOPIC# 1

OFFICE:

METROLOGY NEEDS TO BE PERFORMED ON GRAZING INCIDENCE REFLECTION OPTICS IN ORDER TO MEASURE THE SURFACE HEIGHT PROFILE, CURVATURE, SLOPE ERRORS, AND RESIDUAL ROUGHNESS OVER THE SPATIAL FREQUENCY RANGE FROM 1 MM UP TO 1 METER WITH 0.1 ARC SECOND REPEATABILITY. GRAZING INCIDENCE SYNCHROTRON RADIATION AND OTHER HIGH-ENERGY LASER MIRRORS ARE TYPICALLY 0.5 TO 1.0 METERS IN LENGTH WITH SURFACE FIGURES THAT ARE USUALLY PLANO, SPHERICAL, CYLINDRICAL, TOROIDAL, OR ELLIPSOIDAL. CURRENTLY, NO SUITABLE METROLOGY INSTRUMENTATION WITH INTERFEROMETRIC ACCURACY EXISTS TO FULLY CHARACTERIZE THESE MIRRORS IN A RAPID NON-CONTACT MANNER GENERAL ENOUGH NOT TO REQUIRE AUXILIARY REFERENCE SURFACES SPECIFIC TO EACH DIFFERENT MIRROR. SUCH AN INSTRUMENT, A LONG-TRACE SURFACE PROFILER, WOULD CONSIST OF A COMPACT OPTICAL HEAD THAT IS SCANNED OVER THE LENGTH OF A LONG, NARROW MIRROR BY A PRECISION AIR-BEARING TRANSLATION STAGE. ANALYSIS ALGORITHMS ARE BEING CREATED TO CONVERT THE RAW SLOPE DATA INTO USEFUL SURFACE PROFILE RESULTS AND TO DEVELOP AND IMPLEMENT A USER-FRIENDLY CONTROL ALGORITHM TO DRIVE THE LINEAR AIR SLIDE AND THE DETECTORS. A LIBRARY OF GEOMETRIC ALIGNMENT MODELS ARE BEING DEVELOPED SPECIFIC FOR EACH GENERIC SURFACE TYPE. THE CONTROL AND ANALYSIS SOFTWARE ARE BEING

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INTEGRATED WITH THE REST OF THE SYSTEM. A SERIES OF TESTS ARE BEING PERFORMED TO DETERMINE THE PERFORMANCE LIMITS OF THE INSTRUMENT AND TO DETERMINE HOW WELL IT COMPARES WITH MEASUREMENTS MADE BY OTHER TECHNIQUES ON PREVIOUSLY-CHARACTERIZED TEST SAMPLES.

FELTECH  
639 ROMERO CANYON RD  
MONTECITO, CA 93108  
CONTRACT NUMBER:  
AVNER AMIR  
TITLE:  
OPTICAL MODE TRAPPING APPLICATIONS IN FREE-ELECTRON LA  
TOPIC# 1 OFFICE:

THE SIGNIFICANCE OF AN OPTICAL MODE TRAPPING (ACTIVE GUIDING) PHENOMENON IN FREE-ELECTRON LASERS (FEL) IS IN THE POSSIBILITY OF MAINTAINING A NARROW OPTICAL BEAM PROFILE ALONG THE INTERACTION REGION. THIS RESULTS IN CONSIDERABLE INCREASE OF GAIN WHICH IS IMPORTANT FOR SHORT-WAVELENGTH DEVICES HAVING TYPICALLY LOW FEL GAIN AND FOR WHICH MIRROR TECHNOLOGY IS NOT YET FULLY DEVELOPED. OTHER IMPORTANT ASPECTS OF GUIDING IS THE STABILITY OF THE GAIN UNDER PERTURBATIONS OF THE ELECTRON BEAM AND THE POSSIBILITY OF BENDING THE LIGHT BEAM TO MAKE A MIRRORLESS RING RESONATOR FEL. OPTICAL MODE TRAPPING IN THE FEL IS BEING INVESTIGATED USING A NOVEL THEORETICAL APPROACH. THE CONFIGURATION OF OPTICAL-KLYSTRON IS BEING USED AS A MEANS TO ENHANCE GUIDING. USING THE OPTICAL-KLYSTRON FEL ONE CAN PROVIDE LARGE GAIN AND PHASE SHIFTS TO THE OPTICAL BEAM WITH A RELATIVELY SMALLER CURRENT DENSITY PROVIDED THE ELECTRON-BEAM IS "COLD" ENOUGH. BEAM BENDING AND THE USE OF RING RESONATOR AS A MEANS TO STORE RADIATION FOR SHORT-WAVELENGTHS FEL IS BEING STUDIED. MICROUNDULATOR TECHNOLOGY IS ONE AVENUE TOWARD SCALING DOWN EXISTING FEL'S. UNDER THE INTERACTION WITH LARGE ENOUGH CURRENT DENSITY, THE BEAM IS ANTICIPATED TO BE ACTIVELY FOCUSED THROUGH THE UNDULATOR CHANNEL. THUS, FOCUSING EFFECTS AS A MEANS TO IMPROVE INTERACTION IN A MICROUNDULATOR FEL ARE BEING ANALYZED.

FIBER MATERIALS INC  
BIDDEFORD INDUSTRIAL PK  
BIDDEFORD, ME 04005  
CONTRACT NUMBER:  
JOHN J WOODS  
TITLE:  
ULTRA-LIGHT BRAIDED EXIT CONE DEVELOPMENT PROGRAM  
TOPIC# 2 OFFICE:

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PAYLOAD WEIGHT SAVING IS OF CRITICAL IMPORTANCE TO KINETIC ENERGY WEAPONS SINCE IT TRANSLATES INTO COST SAVINGS. A CHEMICALLY PROPELLED INTERCEPTOR EXIT CONE OR ATTITUDE ADJUSTMENT JET IS BEING DEVELOPED WITH HIGHER STRENGTH, GREATER RELIABILITY AND MINIMUM OF FIFTY PERCENT LESS WEIGHT THAN CURRENT STATE-OF-THE-ART EXIT CONE MATERIALS. PROPERTY PARAMETER OF THE PROPOSED EXIT CONE BEING ADDRESSED INCLUDE WALL THICKNESS, MAXIMUM POROSITY, BULK DENSITY, AND HOOP TENSILE STRENGTH. A SERIES OF THIN WALL PROTOTYPE CONES WITH VARIATIONS IN BRAIDED WEAVE ARCHITECTURE, DENSIFICATION TECHNIQUES, MULTIPLE LAYER COMPACTION TECHNIQUES AND MATRIX MATERIALS ARE BEING MANUFACTURED. PHYSICAL AND MECHANICAL TESTING ON SUCCESSFUL CONES IS BEING PERFORMED. FEASIBILITY OF SIGNIFICANT WEIGHT SAVINGS, HIGHER STRENGTHS AND GREATER RELIABILITY OVER CURRENT STATE-OF-THE-ART EXIT CONE MATERIALS IS BEING DETERMINED, AND DEVELOPMENT AREAS WHICH WOULD OPTIMIZE AND FINALIZE THE MANUFACTURING APPROACH ARE BEING IDENTIFIED.

FIBERTEK INC  
510-A HERNDON PKWY  
HERNDON, VA 22070  
CONTRACT NUMBER:  
DR WALTER KOECHNER  
TITLE:  
HIGHLY DIRECTIONAL AND SENSITIVE GAMMA/NEUTRON DETECTOR  
TOPIC# 3                      OFFICE:

A HIGHLY SENSITIVE AND DIRECTIONAL NUCLEAR RADIATION DETECTION SYSTEM, RESPONDING TO LOW-LEVEL GAMMA-RADIATION AND LOW NEUTRON FLUX, WOULD BE IMPORTANT IN THE AREA OF DECOY DISCRIMINATION AND/OR AS A WARNING DEVICE AGAINST THREAT PARTICLE BEAM WEAPONS. FOR EXAMPLE, ACTIVE ILLUMINATION OF A POTENTIAL SPACE THREAT WITH A PARTICLE BEAM REQUIRES A HIGHLY DIRECTIONAL SENSOR FOR DISCRIMINATION PURPOSES. ONE APPROACH TO ADDRESS THIS NEED IS A DETECTOR COMPRISED OF A TIGHTLY PACKAGED ARRAY OF SCINTILLATOR OPTICAL FIBERS CONNECTED ON EITHER END TO A MICROCHANNEL PMT. A DESIGN ANALYSIS IS BEING PERFORMED TO OPTIMIZE THE DIRECTIONALITY OF THE PROPOSED SYSTEM. THE TRADE-OFFS BEING EXAMINED INCLUDE THE LENGTH-TO-DIAMETER RATIO OF A PARTICULAR SCINTILLATOR FIBER, ENERGY SPECTRUM OF IONIZING RADIATION ABSORPTION CROSS SECTIONS AND THE TOTAL NUMBER OF PLASTIC INORGANIC FIBERS. A SIMPLE DEMONSTRATION UNIT IS BEING DESIGNED AND ASSEMBLED BASED UPON

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PROPRIETARY HARDWARE ALREADY DEVELOPED. THE SYSTEM FEATURES SEVERAL RADIATION SENSITIVE FIBERS AND CONFIGURATIONS AND A SEGMENTED MICROCHANNEL PMT. THE SENSITIVITY AND DIRECTIONALITY OF THE DEMONSTRATION UNIT IS BEING TESTED. A SYSTEM FOR COMMERCIAL USE CAN BE DESIGNED FOR MONITORING RADIATION IN A NUCLEAR POWER PLANT OR LEAKAGE FROM NUCLEAR STORAGE FACILITIES.

FOSTER-MILLER INC  
350 SECOND AVE  
WALTHAM, MA 02254  
CONTRACT NUMBER:  
ROGER L DEMLER  
TITLE:  
PHASE CHANGE POLYMER MICROCOMPOSITE FOR MOVING BELT RA  
TOPIC# 7                      OFFICE:

THE MANAGEMENT AND REJECTION OF HIGH HEAT LOADS FROM SPACECRAFT IS A CRITICAL DESIGN REQUIREMENT OF FUTURE SPACE MISSIONS. THE FEASIBILITY IS BEING INVESTIGATED OF A NOVEL ADVANCED BELT DESIGN FOR A MOVING BELT RADIATOR (MBR) FOR SPACE APPLICATIONS. THE BELT DESIGN CONCEPT INCLUDES THERMAL STORAGE THROUGH THE USE OF AN INTEGRATED PHASE CHANGE MATERIAL (PCM) IMPREGNATED IN AN ORDERED POLYMER MATRIX (PBT). THE RESULTING BELT COMBINES THE EXTREME STRENGTH AND TOUGHNESS OF THE CARRIER POLYMER AND THE BENEFICIAL THERMAL PROPERTIES OF THE PCM. IMPROVED BELT HEAT ACQUISITION, TRANSPORT AND REJECTION COULD RESULT, WHILE THE OVERALL BELT COULD BE VERY RESISTANT TO DEGRADATION IN THE SPACE ENVIRONMENT AS A RESULT OF SPECIAL SURFACE TREATMENTS. MICROCOMPOSITE TEST SAMPLES ARE BEING FABRICATED, AND PERFORMANCE TO COMPETING BELT DESIGNS COMPARED. THE EFFORT INCLUDES THE CONDUCT OF KEY TESTS IN A VACUUM CONTACT HEAT TRANSFER TEST RIG. THE SUCCESSFUL DEMONSTRATION OF A POLYMER MICROCOMPOSITE BELT FOR MBRS COULD BE USED ON THE SPACE STATION, LARGE POWER-CONSUMING MILITARY SPACECRAFT, OR COMMERCIAL SATELLITES THAT CONSUME LARGE AMOUNTS OF POWER.

FOSTER-MILLER INC  
350 SECOND AVE  
WALTHAM, MA 02254  
CONTRACT NUMBER:  
UDAY K KASHALIKAR  
TITLE:  
HIGHLY DAMPED GrMg COMPOSITES FOR SPACE STRUCTURES  
TOPIC# 13                      OFFICE:

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GRAPHITE-MAGNESIUM METAL MATRIX COMPOSITES (MMCS) ARE IDEAL MATERIALS FOR SPACE STRUCTURE APPLICATIONS DUE TO THEIR HIGH STRENGTH AND STIFFNESS, LIGHT WEIGHT, NO OUTGASSING, GOOD THERMAL AND ELECTRICAL CONDUCTIVITY, AND GOOD RESISTANCE TO THE SPACE ENVIRONMENT. A PARTICULARLY URGENT NEED IS FOR A MATERIAL WITH EXCELLENT DAMPING AND FATIGUE PROPERTIES COMBINED WITH HIGH STIFFNESS AND STRENGTH OF MMCS TO DEVELOP STRUCTURES FOR SPACE-BASED KINETIC ENERGY WEAPONS. A CONTINUOUS FIBER GR/MG METAL MATRIX COMPOSITE MATERIAL IS BEING DEVELOPED WITH LARGE IMPROVEMENTS IN MATERIAL DAMPING, DAMAGE TOLERANCE, FATIGUE RESISTANCE, AND FRACTURE TOUGHNESS. ENHANCING MATERIAL DAMPING IS BEING PURSUED BY DEVELOPING A CONTINUOUS FIBER MMC WITH GREATLY REDUCED FRICTIONAL STRESSES AT FIBER/MATRIX INTERFACES. THIS WOULD PERMIT LARGE INCREASES IN ENERGY LOSS INTERFACES DUE TO INTERFACIAL SLIP UNDER EXTERNAL DYNAMIC LOADING. IMPROVEMENTS IN OTHER DYNAMIC PROPERTIES COULD FOLLOW AS A RESULT OF LOWER RESIDUAL STRESS LEVEL IN THE MATRIX. THE FEASIBILITY OF THE CONCEPT AND OF THE TECHNIQUES SUGGESTED ARE BEING EVALUATED TO REDUCE INTERFACE FRICTIONAL COEFFICIENT AND RESIDUAL STRESSES IN MMC STRUCTURES. THIS WORK COULD FORM THE FOUNDATION FOR MORE COMPLEX PROBLEMS SUCH AS SANDWICH STRUCTURES, JOINTS AND LARGE COMPONENTS.

FOSTER-MILLER INC  
350 SECOND AVE  
WALTHAM, MA 02254  
CONTRACT NUMBER:  
DR RICHARD WEISMAN  
TITLE:  
HIGH STRENGTH ELECTRICAL INSULATION COMPOSITES  
TOPIC# 5                      OFFICE:

ELECTROMAGNETIC GUNS PRESENT AN EXTREMELY HARSH ENVIRONMENT FOR DIELECTRIC MATERIALS USED AS INSULATING RAILS. THE COMBINATION OF A PROPRIETARY ARAMID AND MICA PAPER WITH AN EPOXY RESIN IMPREGNANT HAS BEEN SUCCESSFULLY DEVELOPED TO MEET THE SEVERE MECHANICAL REQUIREMENTS FOR INSULATION OF A HIGH VOLTAGE ARMATURE WINDING IN AN ELECTRICAL GENERATOR WITH A SUPERCONDUCTING FIELD WINDING. BASED ON THE SUCCESSFUL FABRICATION TECHNIQUES DEVELOPED FOR THIS INSULATING COMPOSITE, FABRICATION METHODS AND MECHANICAL AND ELECTRICAL PROPERTIES (RELEVANT TO THE REQUIREMENTS OF ELECTROMAGNETIC GUN

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INSULATORS) OF FOUR TYPES OF INSULATING COMPOSITES ARE BEING EXAMINED. THESE COMPOSITES ARE UTILIZING TWO REINFORCING MATERIALS: THE PROPRIETARY PAPER NOTED ABOVE AND POLY P-PHENYLENE BENZOBISTHIAZOLE; AND TWO TYPES OF MATRIX MATERIALS: RESIN SYSTEMS AND SOL-GEL GLASSES. IF SUCCESSFUL, THE INSULATING COMPOSITES WOULD PROVIDE SIGNIFICANTLY BETTER INSULATING MATERIALS FOR ELECTROMAGNETIC GUNS. IN ADDITION, THESE MATERIALS HAVE POTENTIALLY WIDE APPLICATION AS INSULATING MATERIALS IN LARGE ROTATING MACHINES AND POWER TRANSFORMERS. HIGH MECHANICAL STRENGTH, THERMAL STABILITY AND HIGH ELECTRICAL STRENGTH ARE FACTORS WHICH WILL PERMIT MORE RELIABLE AND COST EFFECTIVE ELECTRICAL EQUIPMENT.

FOSTER-MILLER INC  
350 SECOND AVE  
WALTHAM, MA 02254  
CONTRACT NUMBER:  
ROGER L DEMLER

TITLE:  
MICROPUMP TO ENHANCE PERFORMANCE OF HEAT PIPES IN SPAC  
HEAT REJECTION APPLICATIONS  
TOPIC# 7                      OFFICE:

THE MERITS ARE BEING DETERMINED OF USING A SMALL BOOST PUMP TO ENHANCE THE OPERATIONAL FLEXIBILITY AND CAPACITY OF HEAT PIPES IN SPACE. A SMALL PITOT PUMP WITH AN INTEGRAL VAPOR SEPARATOR IS PLACED ADJACENT TO THE CONDENSER PORTION OF A CONVENTIONAL HEAT PIPE TO PUMP FLUID DIRECTLY BACK TO THE EVAPORATOR, BYPASSING ANY CAPILLARY PUMPING DEVICES. THE RESULTING INCREASE IN FLUID PRESSURE, PLUS THE ADDED ABILITY TO MOVE FLUID WHEN DESIRED, COULD RESULT IN A DRAMATIC IMPROVEMENT IN HEAT PUMP PERFORMANCE THAT MORE THAN OFFSETS THE PENALTIES FOR ADDED POWER CONSUMPTION. A SUITABLE PIPE PROTOTYPE AND LIQUID PUMP IS BEING ANALYZED, DESIGNED, AND TESTED. THE RESULTS COULD LEAD TO A RECOMMENDED APPROACH FOR APPLYING THE CONCEPT TO A SPECIFIC MISSION. THE USE OF A SMALL LIQUID PUMP IN CONJUNCTION WITH A HEAT PIPE COULD PRODUCE THE FOLLOWING BENEFITS: LOWER HEAT PIPE SPECIFIC WEIGHT, SELF-PRIMING, OPERATION IN ALL ORIENTATIONS AND G FIELDS, AND A DOUBLING OF RADIATOR CAPACITY WHEN USED AS A BOOST PUMP. DEFENSE, RESEARCH, AND COMMERCIAL SATELLITES WOULD BENEFIT, ESPECIALLY WHEN INTERMITTENT HEAT LOADS ARE APPLIED. COMMERCIAL

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APPLICATIONS WOULD INCLUDE REACTOR COOLING SYSTEMS AND OTHER  
TERRESTRIAL USES, PARTICULARLY WHERE INTERMITTENT HEAT LOADS MAY BE  
EXPERIENCED.

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350 SECOND AVE  
WALTHAM, MA 02254

CONTRACT NUMBER:

ROGER L DEMLER

TITLE:

DIRECT CONTACT HEAT EXCHANGER CONTAINING AN INTEGRAL T  
CAPACITOR

TOPIC# 5

OFFICE:

IN HIGH-POWER-CONSUMING SPACE-BASED SYSTEMS, IT IS LIKELY THAT A  
THERMAL TRANSPORT LOOP WOULD BE EMPLOYED THAT IS SEPARATE FROM THE  
HEAT REJECTION DEVICES, SUCH AS HEAT PIPE RADIATORS, IN ORDER TO  
MINIMIZE THE POTENTIAL OF A TOTAL LOSS OF HEAT TRANSFER FLUID FROM THE  
HEAT REJECTION SYSTEM IF IT IS PENETRATED BY A MICROMETEORITE OR A  
WEAPON. SUCH A DESIGN REQUIRES A THERMAL INTERFACE BETWEEN THE MAIN  
LOOP AND THE RADIATORS, NECESSITATING THE USE OF ONE OR MORE HEAT  
EXCHANGERS. THE FEASIBILITY IS BEING INVESTIGATED OF DEVELOPING A  
DIRECT CONTACT HEAT EXCHANGER THAT CONTAINS AN INTEGRAL THERMAL  
CAPACITOR (TC). THE TC CONCEPT CONSISTS OF AN ORDERED POLYMER MATRIX  
THAT EXHIBITS VOIDS OF UP TO 50 PERCENT BY VOLUME WHEN FABRICATED.  
THE VOIDS ARE THEN IMPREGNATED WITH A COMPATIBLE PHASE CHANGE MATERIAL  
(PCM). THE RESULTING TC IS EXPECTED TO EXHIBIT THE EXTREME STRENGTH  
AND TOUGHNESS OF THE CARRIER POLYMER AND THE BENEFICIAL PROPERTIES OF  
THE PCM. THE TC IS USED TO ATTENUATE PEAK THERMAL LOADS FROM A PULSED  
POWER SYSTEM, AND PERMIT HEAT REJECTION RADIATORS TO BE SIZED BASED ON  
THE AVERAGE HEAT REJECTION RATE RATHER THAN THE PEAK VALUE. A  
SUITABLE PCM IS BEING SELECTED AND MICROCOMPOSITE TEST SAMPLES ARE  
BEING FABRICATED AND TESTED TO MEASURE KEY THERMAL PROPERTIES AND  
MECHANICAL STABILITY OF THE SAMPLES.

FOSTER-MILLER INC  
350 SECOND AVE  
WALTHAM, MA 02254

CONTRACT NUMBER:

PAUL J MARINACCIO

TITLE:

BISTABLE ORGANIC POLYMER NONLINEAR OPTICAL DEVICES

TOPIC# 11

OFFICE:

SUBMITTED BY  
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OPTICAL COMPUTING PROMISES TO EXCEED THE CAPABILITY OF PRESENT DAY MACHINES BY SEVERAL ORDERS OF MAGNITUDE. MUCH HIGHER SPEEDS AND HIGH INFORMATION DENSITY MAKE OPTICAL TECHNOLOGY PROMISING FOR LARGER SCALE PARALLEL PROCESSING. NEW DEVELOPMENTS IN NONLINEAR OPTICAL MATERIALS AND DEVICE FABRICATION TECHNOLOGIES ARE NEEDED TO REALIZE THE POTENTIAL. BISTABLE DEVICES ARE ONE APPROACH TO ADDRESS THIS ISSUE. PROTOTYPE BISTABLE OPTICAL DEVICES ARE BEING INVESTIGATED USING THE HIGH NONLINEAR-SUSCEPTIBILITY OF THIN FILMS OF POLY-P-PHENYLENE BENZOBISTHIAZOLE (PBT). A PROCESS RECENTLY HAS BEEN DEVELOPED FOR PRODUCING THESE FILMS OF THE LIQUID CRYSTALLINE POLYMER PBT. THE  $X(E3)$  VALUES AND THE HIGH LASER DAMAGE OF THE MATERIAL MAKE IT A LEADING CANDIDATE FOR NONLINEAR OPTICAL DEVICES. TWO BISTABLE DEVICES ARE BEING DEVELOPED EXPLOITING THE OPTICAL AND PHYSICAL PROPERTIES OF THE MATERIAL.

FOSTER-MILLER INC  
350 SECOND AVE  
WALTHAM, MA 02254  
CONTRACT NUMBER:  
LAWRENCE H DOMASH  
TITLE:  
OPTICAL CELLULAR AUTOMATON COMPUTER FOR MASSIVELY PARA  
SYMBOLIC PROCESSING  
TOPIC# 11                      OFFICE:

STRATEGIC DEFENSE COMPUTING NEEDS CALL FOR MASSIVELY PARALLEL DATA PROCESSING FOR BATTLE MANAGEMENT, AND THE ABILITY TO GO BEYOND NUMERICAL CALCULATIONS TO DIRECT SYMBOLIC PROCESSING. A NEW APPROACH TO ALL-OPTICAL COMPUTING IS BEING STUDIED BASED ON A CELLULAR AUTOMATON ARCHITECTURE NEVER BEFORE DEMONSTRATED IN AN ALL-OPTICAL CONTEXT. TO MAKE THIS POSSIBLE, THE NONLINEAR TRIPLE PROCESSOR DEVICE IS BEING EXTENDED TO INTRODUCE FULL THREE-PORT ADDRESSING. THE RESULTING GENERIC COMPUTING DEVICE, CONSISTING IN ITS ENTIRETY OF A SINGLE CRYSTAL OR FILM OF THIRD-ORDER NONLINEAR MATERIAL, COULD BE CASCADED TO IMPLEMENT NUMERICAL, SYMBOLIC OR IMAGE PROCESSING ALGORITHMS. SPECIFIC DESIGNS ARE BEING DEVELOPED FOR THE IMPLEMENTATION OF A BASIC 2D CELLULAR AUTOMATON OFTEN MODELED ON DIGITAL COMPUTERS. THE OPTICAL COMPUTING SYSTEM COMBINES HOLOGRAPHIC PRINCIPLES WITH NONLINEAR OPTICS IN A UNIFIED STRATEGY OF MATERIALS,



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DEVICE AND ARCHITECTURE DEVELOPMENT. PHOTOREFRACTIVE CRYSTALS WILL BE THE BASIS FOR FIRST STAGE PROOF-OF-CONCEPT STUDIES. LATER IMPLEMENTATION IN ORGANIC FILMS COULD LEAD TO 1,000 X 1,000 PIXEL SYMBOLIC PROCESSING ON PICOSECOND TIME SCALES. OTHER NOVEL APPLICATIONS OF THE EXTENDED TRIPLE PROCESSOR CONCEPTS COULD BE FIBER OPTIC CROSSBAR SWITCHING, ROBUST PATTERN RECOGNITION, AND OTHER FUNCTIONS REQUIRED BY STRATEGIC DEFENSE.

FOSTER-MILLER INC  
350 SECOND AVE  
WALTHAM, MA 02254  
CONTRACT NUMBER:  
RICHARD W LUSIGNEA

TITLE:

LIGHTWEIGHT CRYOGENIC FLUID TANKS FOR SPACE-BASED SYST

TOPIC# 6

OFFICE:

CRYOGENIC FUEL TANK MATERIALS HAVING HIGH SPECIFIC STRENGTH AND STIFFNESS, GOOD DIMENSIONAL STABILITY, AND GOOD ENVIRONMENTAL RESISTANCE ARE NEEDED FOR USING LIQUID HYDROGEN AND METHANE FUELS IN PROPULSION, TRANSPORTATION AND SPACE-BASED SYSTEMS. CURRENTLY USED METALS LACK THE DESIRED WEIGHT TO STIFFNESS RATIO WHILE ADVANCED COMPOSITE MATERIALS SUCH AS GRAPHITE/EPOXY SHOW MATRIX FAILURE DURING TEMPERATURE CYCLING. A HIGH-PERFORMANCE ORDERED POLYMER, POLY P-PHENYLENE BENZOBISTHIAZOLE (PBT), CAN BE USED IN FILM FORM TO MAKE LIGHTWEIGHT CRYOGENIC FLUID TANKS WHICH EXCEED THE PERFORMANCE OF CURRENT MATERIALS. THIS LIGHTWEIGHT POLYMER FILM HAS A SELF-REINFORCING RIGID-ROD STRUCTURE WHICH IS EXPECTED TO YIELD THE DESIRED ADVANCED COMPOSITE STRENGTH WITHOUT THE DRAWBACKS OF FIBER-BASED COMPOSITE MATERIALS. THE EXCELLENT PROPERTIES OF PBT FILM AT LOW TEMPERATURE IS BEING EVALUATED INCLUDING STRENGTH STIFFNESS AND VERY LOW PERMEABILITY TO HYDROGEN. PBT FILM CAN BE USED AS A STRUCTURAL TAPE IN INNOVATIVE PRESSURE VESSEL DESIGNS TO MAKE A CRYOGENIC FLUID TANK WITH REDUCED WEIGHT, REDUCED LEAKAGE, AND IMPROVED DURABILITY OVER CURRENT ADVANCED MATERIALS SUCH AS GRAPHITE/EXPOXY. PBT FILM ALSO COULD BE USED AS A TANK LINER TO IMPROVE THE PERFORMANCE OF MORE CONVENTIONAL DESIGNS. THIS WILL RESULT IN REDUCED TRANSPORTATION COSTS, IMPROVED RELIABILITY, AND MORE EFFECTIVE LOGISTICS.

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FOSTER-MILLER INC  
350 SECOND AVE  
WALTHAM, MA 02254  
CONTRACT NUMBER:  
RICHARD W LUSIGNEA  
TITLE:  
FILM-BASED COMPOSITE STRUCTURES FOR ULTRALIGHTWEIGHT S  
SYSTEMS  
TOPIC# 12                      OFFICE:

FILM-BASED COMPOSITE STRUCTURES COULD MEET THE REQUIREMENTS OF HIGHLY WEIGHT-EFFICIENT SPACE-BASED SYSTEMS. THESE STRUCTURES WOULD BE RIGID, LIGHTWEIGHT, DIMENSIONALLY STABLE, AND POSSESS A HIGH DEGREE OF STRUCTURAL DAMPING. LAMINATES AND ASSOCIATED THIN-WALLED STRUCTURES MADE FROM SELF-REINFORCED ORDERED POLYMER FILMS WOULD OVERCOME DRAWBACKS OF FIBER-REINFORCED COMPOSITES, AND PROVIDE RESISTANCE TO MICROCRACKING, PLY DELAMINATION AND IMPACT RESISTANCE AS WELL AS HAVING HIGH TEMPERATURE CAPABILITY (OVER 300C), LOW TEMPERATURE (CRYOGENIC) CAPABILITY, AND THE CAPABILITY FOR HARDENING AND SURVIVABILITY. FABRICATION TECHNIQUES FOR ORDERED POLYMER FILM-BASED STRUCTURES ARE BEING EXAMINED THAT WOULD PROVIDE MAJOR ADVANTAGES TO SPACE SYSTEMS. REQUIREMENTS FOR HIGH PERFORMANCE THIN-WALLED STRUCTURES ARE BEING IDENTIFIED THAT MEET STRATEGIC DEFENSE REQUIREMENTS, BUT MAY BE BEYOND THE CAPABILITIES OF CURRENT MATERIALS. PBT FILM IPN COMPOSITE MATERIALS ARE BEING FABRICATED AS ARE SIMPLE STRUCTURES WITH CONTROLLED VOLUME FRACTIONS OF PBT FROM 50 PERCENT TO OVER 80 PERCENT AND CONTROLLED ORIENTATIONS OF PBT FROM UNIAXIAL THROUGH BALANCED BIAXIAL. THESE LAMINATES ARE BEING EVALUATED FOR SPECIFIC STIFFNESS (TARGET VALUE OVER  $10E8$  IN.) AND COEFFICIENT OF THERMAL EXPANSION. THE USE OF PBT FILM LAMINATES IN THIN-WALLED SPACE STRUCTURES ALSO IS BEING EVALUATED.

GELTECH INC  
BOX 18 - ONE PROGRESS BLVD  
ALACHUA, FL 32615  
CONTRACT NUMBER:  
SHI HO WANG  
TITLE:  
HIGH INTENSITY SOLAR POWERED LASER  
TOPIC# 1                      OFFICE:

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GLASS LASERS PRESENTLY HAVE A GREAT POTENTIAL FOR HIGH POWER LASER APPLICATIONS WITH ADVANTAGES THAT INCLUDE THE ABILITY TO FABRICATE LARGE RODS OR SEGMENTS; A HIGH DEGREE OF HOMOGENEITY REDUCING HIGH POWER STRESS CONCENTRATION; AND RARE-EARTH SENSITIZERS USED TO INCREASE EFFICIENCY. ALTHOUGH A PROMISING FIELD, SEVERAL DIFFICULTIES LIMIT THE OUTPUT PER PULSE BEFORE DEFOCUSING AND FILAMENTARY BREAKDOWN OCCURS. THE HIGH TEMPERATURES REQUIRED BY TRADITIONAL MELT-GLASS PROCESSES LEAD TO CONTAMINATION OF THE GLASS BY REACTIONS WITH THE PLATINUM CRUCIBLE. THESE CONTAMINANTS LEAD TO EVENTUAL LASER ROD DESTRUCTION AT HIGH POWERS. ALTERING THE GLASS COMPOSITION BY ADDING CAO OR LI2O ACHIEVES A LOWER MELT TEMPERATURE; HOWEVER, THE PHYSICAL PROPERTIES OF THE GLASS ARE SIGNIFICANTLY DEGRADED. SOL GEL GLASS PROCESSING OFFERS A LOW TEMPERATURE METHOD FOR PRODUCING A SILICA GLASS LASER HOST WITH A PURITY UNATTAINABLE BY ANY OTHER TECHNOLOGY. INITIAL RESULTS INDICATE PHYSICAL PROPERTIES FAR SUPERIOR TO ANY GLASS LASER COMPOSITIONS USED TODAY. THE FEASIBILITY OF MAKING NEODYMIUM DOPED GLASS LASERS USING THE SOL GEL PROCESS IS BEING INVESTIGATED. THE EFFECTS OF ADDING CERIUM OR ERBIUM AS A SENSITIZER ARE BEING DETERMINED.

GENERAL ANALYTICS CORP

155 CLYDE RD  
ATHENS, GA 30605

CONTRACT NUMBER:

DR G ADOMIAN

TITLE:

LARGE SPACE STRUCTURES ANALYSIS FOR VIBRATION HEATING  
CONTROL PROBLEMS

TOPIC# 12

OFFICE:

A MATHEMATICAL METHODOLOGY FOR SOLUTION OF COMPLEX DIFFERENTIAL AND PARTIAL DIFFERENTIAL EQUATIONS MODELING PROBLEMS ASSOCIATED WITH ANALYSIS AND CONTROL OF LARGE SPACE STRUCTURES (THE ADOMIAN DECOMPOSITION METHOD) WOULD MAKE IT POSSIBLE TO PROVIDE ACCURATE AND PHYSICALLY MORE REALISTIC SOLUTIONS OF RELATED NONLINEAR PROBLEMS OF VIBRATION, THERMAL STRESSES, AND CONTROL. THIS APPROACH WOULD SOLVE NONLINEAR PROBLEMS AND/OR PROBLEMS INVOLVING RANDOMNESS WITHOUT THE USUAL APPROXIMATIONS (LINEARIZATION, PERTURBATION, WHITE NOISE) OR NUMERICAL METHODS REQUIRING INTENSIVE COMPUTATION. SOLUTIONS OF

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SPECIFIC APPLICATIONS IN THIS AREA ARE BEING DEMONSTRATED USING THIS NEW METHODOLOGY. RESEARCH ON THE PROBLEM OF NONLINEAR STOCHASTIC AND MULTIDIMENSIONAL CONTROL IS BEING UNDERTAKEN.

GENERAL PNEUMATICS CORP  
7662 E GRAY RD - STE 107  
SCOTTSDALE, AZ 85260  
CONTRACT NUMBER:

DR G WALKER

TITLE:

LOW CAPACITY RELIQUEFIER FOR STORAGE OF CRYOGENIC FLUID

TOPIC# 6 OFFICE:

A SELF CONTAINED LIQUEFIER IS BEING DEVELOPED TO RECONDENSE THE VAPOR BOILOFF FROM THE CRYOGENIC LIQUID STORAGE DEWARS OF LONG LIFE SPACE POWER SYSTEMS. THE PROOF-OF-PRINCIPLE LIQUEFIER FOR THE CHALLENGING DUTY OF HELIUM LIQUEFACTION IS A SMALL LOW CAPACITY (10 LITRES LIQUID HELIUM PER DAY) UNCOMPLICATED SYSTEM HAVING A LONG MAINTENANCE FREE OPERATING LIFE AND LOW INITIAL COST WITH MODEST AUXILIARY REQUIREMENT, I.E., A CONVENTIONAL ELECTRIC POWER SUPPLY AND COOLING WATER. THE LIQUEFIER BEING INVESTIGATED IS A SYNTHESIS OF THREE WELL ESTABLISHED TECHNOLOGIES, SPECIFICALLY A STIRLING CRYOCOOLER WITH A MULTISTAGE EXPANSION ZIMMERMAN DISPLACER USED FOR PRECOOLING COMPRESSED HELIUM IN A JOULE-THOMSON ISENTHALPIC EXPANSION TO LIQUEFY A FRACTION OF THE COMPRESSED HELIUM. THIS LOW CAPACITY HELIUM LIQUEFIER IS BEING DESIGNED FOR SPACECRAFT SUPERCONDUCTING ELECTRONICS HELIUM STORAGE DEWARS. COMPLETE MANUFACTURING DRAWINGS ARE BEING PREPARED FOR THE PROTOTYPE LOW CAPACITY HELIUM LIQUEFIER INCLUDING MATERIAL SPECIFICATION, SELECTED VENDORS, PURCHASED EQUIPMENT AND SCHEDULES.

GT-DEVICES INC  
5705A GENERAL WASHINGTON DR  
ALEXANDRIA, VA 22312

CONTRACT NUMBER:

RODNEY L BURTON

TITLE:

LIQUID PROPELLANT PULSED ELECTROTHERMAL THRUSTER

TOPIC# 6 OFFICE:

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AN ON-ORBIT PROPULSION CAPACITY IS REQUIRED FOR STRATEGIC DEFENSE THAT FEATURES HIGH EFFICIENCY AT A SPECIFIC IMPULSE OF 1000-3000 SECONDS. THIS PROPULSION IS REQUIRED FOR ORBIT TRANSFER, ORBITAL MANEUVERING AND STATION-KEEPING MISSIONS. THE PULSED ELECTROTHERMAL (PET) THRUSTER SEEMS PARTICULARLY ATTRACTIVE FOR THESE APPLICATIONS, AND HAS PREVIOUSLY APPROACHED THE REQUIRED PERFORMANCE LEVELS WITH WATER PROPELLANT IN THRUST STAND EXPERIMENTS. BECAUSE  $10^8$  PULSES OR MORE AT 1500 SECONDS ARE REQUIRED FOR ORBIT TRANSFER AND MANEUVERING MISSIONS, THE TECHNICAL FEASIBILITY OF A LIFE-CYCLE TEST STUDY IS BEING EXAMINED FOCUSING ON THE THRUSTER DESIGN AND FACILITY REQUIREMENTS FOR THE TEST. SUCH PARAMETERS INCLUDE POWER SUPPLY, POWER CONDITIONING, LIQUID PROPELLANT SELECTION AND HANDLING, THERMAL MANAGEMENT, THRUSTER HEAD VACUUM CHAMBER INTERFACE AND VACUUM SYSTEM.

HMJ CORP  
PO BOX 15128  
CHEVY CHASE, MD 20815  
CONTRACT NUMBER:  
WILLIAM D JACKSON  
TITLE:  
POWER CONDITIONING FOR MULTI-MEGAWATT SPACE-ELECTRIC S  
TOPIC# 5                      OFFICE:

THE REQUIREMENT EXISTS FOR ELECTRICAL POWER UP TO 100'S OF MEGAWATTS IN SPACE-BASED MISSIONS. PULSE OPERATION WITH DURATIONS UP TO 1000 SECONDS IS BEING FOCUSED ON PRIMARILY, BUT LONG DURATION STEADY OPERATION IS BEING EXAMINED. CHEMICAL, NUCLEAR AND SOLAR ON-BOARD PRIMARY SOURCES ARE BEING CONSIDERED ALTHOUGH THE AS-GENERATED POWER PRODUCED BY THESE SOURCES USUALLY HAS TO BE CONDITIONED TO MEET THE REQUIREMENTS OF THE LOAD. THE ELECTRICAL CHARACTERISTICS OF THE GENERATORS ASSOCIATED WITH THESE PRIMARY SOURCES ARE BEING ANALYZED. MAGNETOHYDRODYNAMIC GENERATION HAS BEEN SELECTED AS THE SOURCE BECAUSE IT IS THE MOST PROMISING FOR HIGH POWER OPERATION AND HAS THE MOST COMPLEX SOURCE CHARACTERISTICS FROM THE ELECTRICAL VIEWPOINT. THE INVESTIGATION INCLUDES THE DETERMINATION OF THE OPTIMUM CONFIGURATION FOR POWER CONDITIONING TO MEET MULTI-MEGAWATT SPACE SYSTEM REQUIREMENTS; THE KEY PARAMETERS FOR DETERMINING SPECIFIC WEIGHTS; AND AN ASSESSMENT OF THE STATE-OF-THE-ART COMPONENTS FOR LIGHTWEIGHT POWER CONDITIONING AND THE IMPACT OF IMPROVED COMPONENTS ON PERFORMANCE.

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TRANSIENT AND FAULT BEHAVIOR AND IDENTIFICATION OF CRITICAL  
ENGINEERING DEVELOPMENT ISSUES IS BEING ADDRESSED IN A PRELIMINARY  
MANNER.

HOKENSON CO  
840 S TREMAINE AVE  
LOS ANGELES, CA 90005  
CONTRACT NUMBER:  
DR GUSTAVE J HOKENSON  
TITLE:  
VARIABLE MACH NUMBER WALL JETS FOR CONTROL/PROPULSION  
HYPERVELOCITY PROJECTILES/INTERCEPTORS  
TOPIC# 2                      OFFICE:

THE HUGE EXPANSION OF CHEMICAL PROPULSION EXHAUSTS FROM HYPERVELOCITY  
INTERCEPTORS AND PROJECTILES AT HIGH ALTITUDE RESULTS IN A BILLOWED  
PLUME. THIS PLUME INTERFERES WITH THE FREESTREAM FLOW AND ALLOWS  
LOW-ENERGY NOZZLE BOUNDARY LAYER CONTAMINANTS TO MIGRATE UPSTREAM  
TOWARD THE SENSOR LOCATIONS. GIVEN A CONFIGURATION IN WHICH A  
RELATIVELY SIMPLE MECHANICAL CONTROL COULD ADJUST THE EXIT MACH NUMBER  
AND DIRECTION OF THE EXHAUST, MANY OF THE CURRENT PROBLEMS ASSOCIATED  
WITH CHEMICAL PROPULSION EXHAUSTS MAY BE ALLEVIATED. BY UTILIZING AN  
EXISTING MODEL, THE EFFECTIVENESS OF A WALL JET ON HYPERVELOCITY  
VEHICLES FOR PROPULSION AND/OR CONTROL APPLICATIONS IS BEING EVALUATED  
EXPERIMENTALLY. THE MODEL IS BEING IMMERSSED IN A LOW DENSITY FLOW  
(TRANSITIONAL TO RAREFIED) WITH THE WALL JET FLOWFIELD OBSERVED AND  
NET AXIAL FORCE MEASURED AS A FUNCTION OF THE JET MACH NUMBER AND  
STAGNATION PRESSURE. THE JET EXIT MACH NUMBER IS BEING VARIED FROM 2  
TO 10. SUBSEQUENTLY, A WIND TUNNEL TEST IS EXPECTED TO BE CARRIED  
OUT. MODEL DESIGN MODIFICATIONS ARE BEING PREPARED THAT WOULD BE  
REQUIRED TO ALLOW THE JET TO BE NON-AXISYMMETRIC AND GENERATE  
CROSS-RANGE FORCES AS WELL AS OPERATE IN A STAGED MODE WITH THE  
CONICAL NOSE SEPARATING IMPULSIVELY FROM THE SKIRT. ON THE BASIS OF  
THESE FLOWFIELD VISUALIZATIONS AND AXIAL FORCE MEASUREMENTS, A PLAN  
FOR A COMPREHENSIVE SERIES OF TESTS AT A LATER PHASE ALSO IS BEING  
PREPARED.

HUBB SYSTEMS INC  
PO BOX 424  
HUBBARDSTON, MA 01452  
CONTRACT NUMBER:  
STANLEY J POREDA  
TITLE:  
COMPUTING STRATEGIES FOR STRATEGIC DEFENSE BATTLE MANA  
ASSIGNMENT ALGORITHMS  
TOPIC# 10                      OFFICE:

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STRATEGIC DEFENSE BATTLE MANAGEMENT, COMMAND, CONTROL AND COMMUNICATIONS (BM/C3) FUNCTIONS WILL REQUIRE THE USE OF DATA PROCESSING SYSTEMS THAT ARE SMALL, FAST, LIGHTWEIGHT, NUCLEAR-HARD, RELIABLE, AND CAPABLE OF EXTREMELY HIGH THROUGHPUTS. AS A RESULT, IT IS NOW WIDELY RECOGNIZED THAT SPECIAL PURPOSE PARALLEL COMPUTER ARCHITECTURES AND BM/C3 ALGORITHMS THAT EXPLOIT THEIR COMPUTATIONAL ADVANTAGES WILL BE NEEDED TO MEET THESE REQUIREMENTS. THE BM/C3 FUNCTIONS THAT WILL LEAD TO THE MOST STRESSING DP REQUIREMENTS INCLUDE ASSIGNMENT FUNCTIONS. ONE APPROACH TO THIS PROBLEM IS THE USE OF SPECIAL PURPOSE PARALLEL COMPUTING SYSTEMS AND OF ALGORITHMS THAT ARE TAILORED FOR USE ON THESE SYSTEMS. BM/C3 ASSIGNMENT ALGORITHMS ARE BEING DEVELOPED THAT CAN BE EXECUTED ON MULTI MICROCOMPUTER SYSTEMS. THESE ALGORITHMS ARE BEING BASED ON EXISTING ALGORITHMS THAT USE GRAPH SEARCH TECHNIQUES. MULTI MICROCOMPUTER ARCHITECTURES WHICH WOULD SERVE AS SUITABLE HOSTS FOR THESE PARALLEL ALGORITHMS ARE ALSO BEING IDENTIFIED.

INTEGRATED SYSTEMS INC  
2500 MISSION COLLEGE BLVD  
SANTA CLARA, CA 95054  
CONTRACT NUMBER:  
DR NAREN K GUPTA

TITLE:  
GRAPHICAL VERY HIGH LEVEL LANGUAGE FOR DEVELOPMENT AND  
OF LARGE SOFTWARE SYSTEMS  
TOPIC# 10                      OFFICE:

THE DEVELOPMENT AND TESTING OF SOFTWARE IS BECOMING MORE AND MORE THE KEY PROBLEM IN NEW ELECTRONIC SYSTEMS. THE CONTINUOUS DROP IN THE COST, SIZE AND POWER REQUIREMENTS OF ELECTRONIC HARDWARE HAS MADE IT POSSIBLE TO USE EXTREMELY SOPHISTICATED SOFTWARE IN BATTLE MANAGEMENT AND OTHER STRATEGIC DEFENSE SYSTEMS. THIS HAS LEAD TO THE NEED FOR EXTREMELY LARGE AND COMPLEX SOFTWARE. LITTLE HAS BEEN DONE TO BRING ABOUT LARGE DECREASES IN SOFTWARE DEVELOPMENT COSTS. INITIAL DEVELOPMENT COSTS, RELIABILITY, AND MAINTENANCE COSTS HAVE NOT IMPROVED SIGNIFICANTLY. EXTREMELY HIGH SOFTWARE RELIABILITY ALSO REQUIRES THE DEVELOPMENT OF NEW TOOLS. THE FEASIBILITY OF DEVELOPING A GRAPHICAL VERY HIGH LEVEL LANGUAGE IS BEING INVESTIGATED FOR THE DEVELOPMENT AND TESTING OF COMPLEX AND LARGE SOFTWARE SYSTEMS. THE

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GOAL IS TO DEVELOP THE TECHNOLOGY OF PROGRAMMING WITH PICTURES WHERE THE SOFTWARE SPECIFICATIONS AND PROCEDURE DESCRIPTIONS ARE ENTERED GRAPHICALLY. A COMPLETE COMPUTER-AIDED SOFTWARE ENGINEERING TOOLSET IS BEING DEVELOPED AROUND THIS TECHNOLOGY. THREE KEY AREAS ASSOCIATED WITH THIS TOOLSET ARE BEING STUDIED: GRAPHICAL SOFTWARE SPECIFICATION METHODOLOGY AND PROCEDURES; DATABASE TECHNOLOGY TO STORE, RETRIEVE AND MANIPULATE THE GRAPHICAL DESCRIPTIONS; AND AUTOMATED CODE GENERATION IN A COMPUTER LANGUAGE. THIS EFFORT, IF SUCCESSFUL, WOULD REDUCE DEVELOPMENT COST AND TIME BY A FACTOR OF TEN OR MORE, AND SUBSTANTIALLY LOWER THE NUMBER OF HIDDEN BUGS.

INTELLIGENT AUTOMATION INC  
1715 GLASTONBERRY RD  
ROCKVILLE, MD 20854  
CONTRACT NUMBER:  
LEONARD S HAYNES  
TITLE:  
HIERARCHICAL STATE TABLE DRIVEN SOFTWARE ARCHITECTURE  
STRATEGIC DEFENSE BATTLE MANAGEMENT  
TOPIC# 10                      OFFICE:

THE STRATEGIC DEFENSE BATTLE MANAGEMENT SYSTEM WILL BE THE LARGEST SINGLE SOFTWARE SYSTEM EVER BUILT. IN ADDITION TO ITS SIZE, THE SYSTEM WILL HAVE OTHER ATTRIBUTES WHICH WILL MAKE THE PROBLEM OF SOFTWARE DESIGN AND VALIDATION MORE COMPLEX THAN ANY SYSTEM EVER BEFORE ATTEMPTED. A GENERAL APPROACH TO REAL-TIME SOFTWARE SYSTEM DESIGN IS BEING EXAMINED THAT HELPS ADDRESS THE ISSUES OF THE ENORMOUS NUMBER OF STATES AND NON-DETERMINISTIC INPUTS OF A BATTLE MANAGEMENT SYSTEM. THE APPROACH DIVIDES THE SOFTWARE INTO HIERARCHICAL CONTROL LEVELS, AND THEN DIVIDES THE CONTROL LEVELS INTO STATE TABLES WHICH IMPLEMENT THE DECISION TREE PROCESSING, AND PROCEDURES WHICH PERFORM COMPUTATION. THE STATE TABLES ASSOCIATED WITH THE CONTROL LEVELS CAN BE SIMPLIFIED TO THE POINT WHERE IT MIGHT BE POSSIBLE TO EXHAUSTIVELY TEST A CONTROL LEVEL. THIS IS EXPECTED TO GREATLY INCREASE CONFIDENCE THAT THE SYSTEM WOULD NOT PRODUCE ERRONEOUS OR UNEXPECTED RESULTS.

INTERMAGNETICS GENERAL CORP  
1875 THOMASTON AVE  
WATERBURY, CT 06704  
CONTRACT NUMBER:  
DR KANITHI HEMACHALAM  
TITLE:  
MULTIFILAMENT SUPERCONDUCTOR FOR USE IN A LIQUID HYDRO  
ENVIRONMENT  
TOPIC# 5                      OFFICE:



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SUPERCONDUCTORS WITH CRITICAL TEMPERATURE ABOVE 90K ARE EXPECTED TO EXPAND GREATLY THE POTENTIAL APPLICATIONS FOR SUPERCONDUCTORS. TO BE TECHNICALLY AND COMMERCIALY USEFUL, THESE MATERIALS WILL HAVE TO BE INCORPORATED INTO METAL MATRIX MULTIFILAMENT CONFIGURATIONS. THE MOST APPROPRIATE SUPERCONDUCTOR WILL BE IDENTIFIED BASED ON TRADE OFFS BETWEEN MULTIFILAMENT FABRICABILITY AND PERFORMANCE. SEVERAL METAL MATRIX MULTIFILAMENT PROCESS TECHNOLOGIES WILL ALSO BE CONSIDERED AND EVALUATED. DEMONSTRATION OF KEY COMPONENTS OF FABRICATION ARE BEING UNDERTAKEN ON SMALL SAMPLES WITH SEVERAL FILAMENTS. THE AVAILABILITY OF A COMMERCIAL MULTIFILAMENT SUPERCONDUCTOR WITH CRITICAL TEMPERATURE ABOVE 90K COULD GREATLY EXPAND THE FEASIBLE ECONOMIC ENVELOPE OF APPLIED SUPERCONDUCTIVITY. HIGH POWER DENSITY, LIGHTWEIGHT SUPERCONDUCTING SYSTEM COOLED BY LIQUID HYDROGEN FOR SPACE AND AIRBORNE USE WOULD BECOME EXTREMELY ATTRACTIVE. DEVICES FOR POWER GENERATIONS, TRANSMISSION AND STORAGE COULD BENEFIT. MEDICAL APPLICATIONS SUCH AS MAGNETIC RESONANCE IMAGING AND ACCELERATORS FOR RADIATION THERAPY WOULD BECOME EVEN MORE COST EFFECTIVE.

INTERMAGNETICS GENERAL CORP  
1875 THOMASTON AVE  
WATERBURY, CT 06704  
CONTRACT NUMBER:  
DR LESZEK MOTOWIDLO  
TITLE:  
FINE REFRACTORY FILAMENTS FOR USE IN COMPLIANT PADS RE  
THERMOELECTRIC DEVICES  
TOPIC# 4                      OFFICE:

THE NEXT GENERATION OF THERMOELECTRIC DEVICES ARE ENVISIONED TO BE DIRECTLY COUPLED TO THE HEAT SOURCE. THIS IS REQUIRED IN ORDER TO INCREASE EFFICIENCY OF CONVERSION TO ELECTRICITY. THE HIGH TEMPERATURE OPERATION, PARTICULARLY, AT THE HOT END (1050C) REQUIRES THE USE OF HIGH MELTING POINT REFRACTORY MATERIALS FOR THE COUPLING MEDIUM. THE TEMPERATURE GRADIENT WHICH EXISTS ACROSS THE THERMOELECTRIC DEVICE RESULTS IN SEVERE BOWING OF THE DEVICE AT THE HOT END. THUS, THE COUPLING BETWEEN THE DEVICE AND HEAT SOURCE NEEDS TO FULFILL COMPLIANCE AS WELL AS GOOD THERMAL CONDUCTIVITY. CURRENT METHODS OF ACCOMMODATING THE DEFLECTION OR BOWING OF THE DEVICE IS ACCOMPLISHED BY A COMPLIANT PAD WHICH IS COMPOSED OF MILLIONS OF FINE

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FILAMENTS. PRESENT METHODS OF FABRICATING HIGH TEMPERATURE COMPLIANT PADS ARE BY INDIVIDUALLY HOT DRAWING OF TUNGSTEN OR MOLYBDENUM FILAMENTS AND ASSEMBLING MILLIONS OF FINE FILAMENTS INTO A ONE INCH SQUARE PAD. COMPOSITE TECHNOLOGY OF MOLYBDENUM FILAMENTS ARE BEING DEVELOPED IN A METAL MATRIX COMPATIBLE TO THE STRENGTH CHARACTERISTICS OF MOLYBDENUM. HYDROSTATIC EXTRUSION AND COLD DRAWINGS ARE BEING STUDIED AS A FUNCTION OF PARAMETERS (SUCH AS DIE ANGLES AND TEMPERATURE) TO OBTAIN HIGH FILAMENT UNIFORMITY, ROUNDNESS AND UNIFORM SPACING REQUIRED FOR COMPLIANT PADS IN THERMOELECTRIC DEVICES FOR SPACE BORNE POWER SYSTEMS.

IONIC ATLANTA INC  
1347 SPRING ST  
ATLANTA, GA 30309  
CONTRACT NUMBER:  
DR KEITH O LEGG  
TITLE:  
IN-SITU ION IMPLANTATIONS FOR VAPOR PHASE EPITAXIAL GR  
DOPED DIAMOND THIN FILMS  
TOPIC# 14                      OFFICE:

THE MICRO-ELECTRONIC ANALYSIS AND CONTROL CIRCUITRY, WHICH WILL FORM THE BRAINS OF SPACE-BASED DEFENSE SYSTEMS, REQUIRE NEW SEMICONDUCTORS WHICH ARE RADIATION HARDENED, EXTREMELY FAST, AND CAPABLE OF HIGH TEMPERATURE, HIGH POWER OPERATION. DOPED ELECTRONIC DIAMOND IS IDEAL FOR THIS APPLICATION BUT CURRENTLY CANNOT BE PRODUCED SATISFACTORILY BECAUSE OF THE DIFFICULTY OF DOPING WITH P AND AS. THIS EFFORT ULTIMATELY AIMS AT FORMING DOPED SINGLE CRYSTAL DIAMOND FILMS SUITABLE FOR ELECTRONIC USE BY ION IMPLANTING THE DOPANT SIMULTANEOUSLY WHILE GROWING THE DIAMOND FILM EPITAXIALLY ON A SINGLE CRYSTAL SUBSTRATE. EXISTING SMALL-SCALE TECHNIQUES ARE BEING DEVELOPED AND ASSESSED FOR EPITAXIAL GROWTH OF DIAMOND FILMS USING PLASMA-ASSISTED METHODS. MEASUREMENTS ARE BEING MADE OF THE CRYSTAL STRUCTURE, MORPHOLOGY, ELECTRICAL CONDUCTIVITY AND CARRIER MOBILITY OF THE FILMS, WITH AND WITHOUT IN-GROWTH IMPLANTED DOPANTS. ONCE SATISFACTORY GROWTH TECHNIQUES ARE ASSURED, FILMS WILL BE ION IMPLANTED DURING GROWTH TO PRODUCE DOPED SEMICONDUCTOR DIAMOND FILMS.

IONIC ATLANTA INC  
1347 SPRING ST  
ATLANTA, GA 30309  
CONTRACT NUMBER:  
DR KEITH O LEGG  
TITLE:  
SPACE-BASED OPTICAL COMPONENTS PROTECTION BY HARD ADHE  
DIAMOND COATINGS  
TOPIC# 13                      OFFICE:

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COATINGS ARE NEEDED TO PROTECT FROM DAMAGE AND DETERIORATION THE LARGE VARIETY OF OPTICAL COMPONENTS WHICH WILL BE USED IN SPACE-BASED DEFENSE SYSTEMS. THESE COATINGS MUST BE TRANSPARENT FROM THE INFRARED TO THE ULTRAVIOLET, HARD, RESISTANT TO EROSION BY ATOMIC OXYGEN AND BY PARTICLES, AND SURVIVABLE UNDER EXTREME TEMPERATURE CYCLING. THE TECHNOLOGY OF PLASMA-AIDED COATING IS BEING DEVELOPED TO APPLY THIN DIAMOND AND DIAMOND-LIKE PROTECTIVE COATINGS TO OPTICAL MATERIALS. THE BEST FEATURES OF PLASMA DEPOSITION PROCESSES ARE BEING COMBINED WITH THOSE OF ION-ASSISTED COATING TO CREATE COATINGS WHICH HAVE HIGH OPTICAL QUALITY AND ADHERE WELL TO ALMOST ANY SUBSTRATE. THE RELATIVE MERITS OF TWO METHODS FOR DEPOSITING DIAMOND COATINGS (PLASMA DEPOSITION AND ION BEAM DEPOSITION) ARE BEING EVALUATED. SUCCESSFUL COATINGS WILL BE ION IMPLANTED TO ENSURE GOOD ADHESION. THE CHEMISTRY, HARDNESS, AND SCRATCH-RESISTANCE OF THE COATINGS ARE BEING MEASURED. THE INITIAL EFFORT WILL ENABLE THE DETERMINATION OF WHICH OF THE DIAMOND DEPOSITION PROCESSES SHOULD BE DEVELOPED IN A LATER PHASE. THE RESULTS OF A SUCCESSFUL PROGRAM WILL BE BROAD-BAND TRANSMITTING COATINGS WHICH WILL BE EXTREMELY HARD, CHEMICALLY STABLE, SCRATCH-RESISTANT, AND APPLICABLE TO ALMOST ANY OPTICAL COMPONENT.

IRVINE SENSORS CORP  
3001 REDHILL AVE - BLDG III/#208  
COSTA MESA, CA 92626  
CONTRACT NUMBER:  
DAVID E LUDWIG  
TITLE:  
GALIUM ARSENIDE INFRARED FOCAL PLANE ARRAY  
TOPIC# 3                      OFFICE:

INFRARED SURVEILLANCE SENSORS AND MISSILE SEEKERS FOR STRATEGIC DEFENSE REQUIRE SIGNIFICANT ON-FOCAL PLANE ARRAY ELECTRONICS TO ACQUIRE AND TRACK TARGETS. THE OPPORTUNITY NOW EXISTS TO TRANSITION INFRARED FOCAL PLANE ARRAY TECHNOLOGY FROM SILICON TO GaAs. THE FEASIBILITY IS BEING ESTABLISHED FOR FABRICATING AND INTERFACING INFRARED DETECTORS WITH RELATIVELY LOW POWER GaAs INTEGRATED CIRCUITS, AND PACKAGING THEM INTO A THREE-DIMENSIONAL MODULE UTILIZING PROPRIETARY TECHNOLOGY. TOGETHER, THESE DEVELOPMENTS OFFER A SIGNIFICANT INCREASE IN RADIATION HARDNESS AND THE SIGNAL PROCESSING ELECTRONICS AREA FOR FOCAL PLANE APPLICATIONS. KEY ISSUES BEING

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RESOLVED ARE THE PROJECTED PERFORMANCE OF GaAs ANALOG CIRCUITS IN TERMS OF NOISE, BANDWIDTH, DYNAMIC RANGE, AND POWER DISSIPATION, AND AVAILABILITY AND QUALITY OF EXISTING FOUNDRY SOURCES. FOUNDRY CAPABILITIES ARE BEING INVESTIGATED AND EVALUATED FOR PROCESSING LINEAR, ANALOG GaAs INTEGRATED CIRCUITS. A GaAs PREAMPLIFIER IS BEING CHARACTERIZED SUITABLE FOR READING OUT INFRARED DETECTORS UTILIZING PRESENTLY AVAILABLE DEVICES. A PRELIMINARY CONCEPTUAL DESIGN IS BEING PREPARED OF A GaAs INTEGRATED CIRCUIT AND "STRAWMAN" PERFORMANCE SPECIFICATIONS ARE BEING DEVELOPED IN TERMS OF NOISE SPECTRUM, DYNAMIC RANGE, AND FREQUENCY RESPONSE FROM COMPUTER ANALYSES.

IRVINE SENSORS CORP  
3001 REDHILL AVE - BLDG III/#208  
COSTA MESA, CA 92626  
CONTRACT NUMBER:  
MARTIN SPANISH  
TITLE:  
ON-FOCAL PLANE ANALOG TO DIGITAL CONVERSION  
TOPIC# 3                      OFFICE:

IN ADVANCED INFRARED FOCAL PLANE ARRAYS (IR FPAS), AS THE NUMBER OF DETECTORS ON THE ARRAY INCREASE AND THE COMPLEXITY OF TARGET DETECTION BECOMES GREATER, THERE IS AN ASTRONOMICAL INCREASE IN SIGNAL PROCESSING NECESSARY TO RESOLVE AND DISCRIMINATE TARGETS SATISFACTORILY. PRE-PROCESSING ON THE FOCAL PLANE TO THE GREATEST EXTENT POSSIBLE IS THEREFORE DESIRABLE, ALTHOUGH IT HAS BEEN LIMITED BY POWER DISSIPATION. THE POWER PROBLEM IS PARTIALLY ADDRESSED BY PERFORMING AS MANY FUNCTIONS AS POSSIBLE IN PARALLEL, WITH ANALOG ELECTRONICS BEHIND EACH DETECTOR. THERE ARE SOME FUNCTIONS THAT CAN BE READILY PERFORMED ONLY DIGITALLY, SUCH AS THRESHOLDING, LONG TERM MEMORY, AND LOGIC. HOWEVER, CURRENT ANALOG TO DIGITAL CONVERTERS (ADC) CONSUME VASTLY MORE POWER THAN CAN BE TOLERATED IN CRYOGENIC IR FPA'S. FEASIBILITY IS BEING EVALUATED OF PERFORMING ON-FOCAL PLANE ANALOG TO DIGITAL CONVERSION FOR LARGE, TWO-DIMENSIONAL IR DETECTOR ARRAYS. A PRELIMINARY ADC DESIGN IS BEING GENERATED AND COMPUTER MODELED TO VERIFY PERFORMANCE WITH INTRINSIC DETECTORS AT LIQUID NITROGEN TEMPERATURES. THE RADIATION HARDNESS OF THE DESIGN IS BEING ANALYTICALLY DEMONSTRATED. THE PRIMARY PERFORMANCE PARAMETERS OF SPEED, RESOLUTION, AND NOISE ARE BEING RELATED TO AREA AND POWER

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REQUIREMENTS, WHICH WOULD DETERMINE COMPATIBILITY WITH HIGH DENSITY IR ARRAYS.

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COSTA MESA, CA 92626  
CONTRACT NUMBER:  
MARTIN SPANISH

TITLE:

LIGHTWEIGHT EXO-ATMOSPHERIC PROJECTILE SEEKERS USING A  
IMAGE AND THREE-DIMENSIONAL FOCAL PLANE TECHNOLOGY

TOPIC# 2

OFFICE:

THE DESIGN OF AN EXO-ATMOSPHERIC PROJECTILE SEEKER REQUIRES THE CAPABILITY TO DETECT AND TRACK TARGETS AGAINST THE BACKGROUND, PARTICULARLY, THE EARTH BACKGROUND RAPIDLY MOVING BEHIND THE TARGET AND PRODUCING A FALSE SIGNAL MASKING THE SLOWLY MOVING TARGET. CURRENT SENSOR TECHNOLOGY HAS NOT BEEN ABLE TO SOLVE THIS PROBLEM. A LIGHTWEIGHT EXO-ATMOSPHERIC PROJECTILE SEEKER APPROACH CAPABLE OF EXTRACTING, ACQUIRING AND TRACKING TARGETS IN THE PRESENCE OF HIGHLY CLUTTERED AND DYNAMIC BACKGROUNDS IS BEING INVESTIGATED. THIS APPROACH TO INFRARED IMAGING, WHICH USES A SCANNED IMAGE AND THREE-DIMENSIONAL FOCAL PLANE TECHNOLOGY TO PUT INTRAFRAME AND INTERFRAME IMAGE PROCESSING ON THE FOCAL PLANE, ALLOWS ON-FOCAL PLANE EXTRACTION OF LOW OBSERVABLES FROM EARTH CLUTTER AND NUCLEAR STRUCTURED ENVIRONMENTS. NORMAL MISSILE BODY MOTION CAN BE USED TO GENERATE THE DITHER SCAN, NEGATING THE NEED FOR SCANNING OPTICS. DATA RATES AND OFF-FOCAL PLANE PROCESSING LOADS ARE REDUCED SUFFICIENTLY TO ELIMINATE THEM AS MAJOR ISSUES IN THE SEEKER DESIGN. THE NATURE OF THE SAMPLING PROCESS ALSO IS EXPECTED TO CONTROL OR ELIMINATE THE EFFECTS OF GAMMA PULSE EVENTS ON THE SENSOR. THE ALGORITHM FOR INCLUSION IN AN INTEGRATED CIRCUIT IS BEING ANALYTICALLY VALIDATED AND THE OPERATING PARAMETERS OF THE INTEGRATED CIRCUIT ARE BEING DEFINED FOR INSERTION IN FUTURE GENERATIONS OF FOCAL PLANE MODULES FOR THE EXO-ATMOSPHERIC PROJECTILE SEEKERS.

KEMP CORP  
1909 MATTHEW LN  
KNOXVILLE, TN 37923  
CONTRACT NUMBER:  
DR FRANCIS E LEVERT

TITLE:

THERMIONIC CONVERSION DEVICE USING DIRECTIONALLY SOLID  
OXIDE COMPOSITES

TOPIC# 4

OFFICE:

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IMPROVEMENTS ARE NEEDED IN THE BARRIER INDEX OF ELECTRON EMISSION FROM THERMIONIC EMITTERS AT OPERATING TEMPERATURES ABOVE 1400C. DIRECTIONALLY SOLIDIFIED (SINGLE CRYSTAL) METAL OXIDE COMPOSITES PROVIDE A UNIQUE OPPORTUNITY TO FORM HIGH-PACKING DENSITY ARRAYS OF LARGE DIAMETER METAL FIBERS THAT ARE SUITABLE FOR APPLICATION AS THERMIONIC EMITTERS IN ENERGY CONVERSION DEVICES. USE OF VARIOUS METAL OXIDES WITH METAL CARBIDE MATRICES SUCH AS THE CATHODE MATERIAL IN THERMIONIC DEVICES IS BEING SUBJECTED TO DETAILED ANALYTICAL AND EXPERIMENTAL INVESTIGATIONS. EXPERIMENTAL DETERMINATION OF THE RELATIVE EFFICIENCIES OF THE METAL-PIN/MATRIX SYSTEMS COMPARED TO PLANAR EMITTERS IS BEING CONDUCTED. SUCCESSFUL COMPLETION OF THIS WORK WOULD LEAD TO THE DEVELOPMENT OF A DIRECT ENERGY CONVERSION DEVICE (THERMIONIC CONVERTER) THAT WOULD MEET MANY OF THE DIVERSE POWER SOURCE NEEDS FOR REMOTE UNMANNED ELECTRIC STATIONS, MILITARY INSTALLATIONS, SPACECRAFTS, AND SPACE STATIONS.

KMS FUSION INC  
PO BOX 1567 - 3853 RESEARCH PARK DR  
ANN ARBOR, MI 48106  
CONTRACT NUMBER:  
K L MARSH  
TITLE:  
RED DIOXETANE-ENERGIZED VAPOR LASER  
TOPIC# 1                      OFFICE:

A DIOXETANE-ENERGIZED VAPOR LASER (DEVL) USING GAS PHASE LANTHANIDE CHELATES AS THE LASANT MATERIAL IS BEING INVESTIGATED IN ORDER TO PROVIDE A HIGH AVERAGE POWER SOURCE OF DIRECTED ELECTROMAGNETIC RADIATION. SUCH CHEMICALLY PUMPED LASERS OFFER THE ADVANTAGES OF EFFICIENT TARGET COUPLING THROUGH HIGH POWER VISIBLE WAVELENGTH OPERATION, SCALABILITY, AND PORTABILITY. THE DEVL LASER IS BEING FUELED BY DIOXETANE, A CLASS OF ORGANIC PEROXIDES WHICH STORE LARGE AMOUNTS OF ENERGY IN CHEMICAL BONDS. THE ENERGY IS RELEASED WITH HIGH EFFICIENCY IN THE FORM OF ELECTRONIC EXCITATION OF PRODUCT MOLECULES UPON CLEAVAGE OF THE DIOXETANE RING. RECENT ADVANCES IN CHEMICAL TRIGGERING OF THE DIOXETANE CLEAVAGE REACTION IN SOLUTION ALLOW RAPID RELEASE OF CHEMICAL ENERGY ON DEMAND. THE ELECTRONICALLY EXCITED PRODUCTS RELEASED BY DIOXETANE CLEAVAGE CAN TRANSFER ENERGY TO A MOLECULE WITH FAVORABLE OPTICAL GAIN CHARACTERISTICS. LANTHANIDE

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CHELATES ARE VOLATILE, EMIT VISIBLE RADIATION, AND PROVIDE A PATHWAY (VIA THE CHELATING LIGAND) FOR TRANSFER OF ENERGY FROM THE ELECTRONICALLY EXCITED DIOXETANE PRODUCTS TO THE LANTHANIDE ION. LASER ACTION ALREADY HAS BEEN DEMONSTRATED IN SOLUTION PHASE FOR A EUROPIUM CHELATE AND THE VOLATILITY AND PHOTOKINETICS OF SEVERAL OF THESE MOLECULES HAS BEEN EXAMINED. THE VOLATILITY OF SELECTED DIOXETANES IS BEING MEASURED AND THE ABILITY TO CHEMICALLY TRIGGER DIOXETANE CLEAVAGE IN THE GAS PHASE IS BEING DEMONSTRATED.

KOPIN CORP  
695 MYLES STANDISH BLVD  
TAUNTON, MA 02780  
CONTRACT NUMBER:  
PAUL ZAVRACKY  
TITLE:  
SURFACE MORPHOLOGY OF SILICON ON INSULATOR FILMS PREPA  
ZONE-MELTING RECRYSTALLIZATION  
TOPIC# 14                      OFFICE:

RESEARCH IS DIRECTED AT TECHNIQUES TO IMPROVE SURFACE MORPHOLOGY IN SILICON ON INSULATOR (SOI) WAFERS PREPARED BY ZONE MELTING RECRYSTALLIZATION (ZMR). THE THREE AREAS OF PRIMARY IMPORTANCE IN IMPROVING THE SURFACE MORPHOLOGY OF ZMR PROCESSED WAFERS ARE: SLIP, BOW AND WARP, AND SURFACE SMOOTHNESS. SLIP IS CAUSED BY THERMALLY INDUCED STRESS THAT RESULTS FROM THE TEMPERATURE GRADIENT IN THE MELT ZONE. METHODS OF REDUCING THIS PROBLEM WILL BE EXAMINED BY VARYING SEVERAL FACTORS INCLUDING THE SUBSTRATE TEMPERATURE, SCAN SPEED, WIRE WIDTH AND SUBSTRATE ORIENTATION. THE ABOVE PARAMETERS WILL ALSO BE VARIED TO IDENTIFY THE EFFECTS ON BOW AND WARP. IN ADDITION, BOW AND WARP MEASUREMENTS WILL BE COMPLETED BEFORE AND AFTER THE ZMR PROCESS TO IDENTIFY POSSIBLE CORRELATION WITH STARTING MATERIAL. SURFACE ROUGHNESS IN ZMR IS DIRECTLY RELATED TO THE QUALITY OF THE STARTING POLYSILICON LAYER. PARAMETERS AFFECTING THE POLYSILICON CVD DEPOSITION WILL BE VARIED TO OPTIMIZE THE QUALITY OF THIS LAYER AND ALTERNATIVE POLYSILICON GROWTH TECHNIQUES WILL ALSO BE STUDIED. SOI MATERIAL OFFERS MANY INHERENT ADVANTAGES OVER CONVENTIONAL SILICON BULK WAFERS: RADIATION HARDNESS, VOLTAGE ISOLATION, IMPROVED SPEED PERFORMANCE, GREATER PACKING DENSITY, AND CMOS LATCH-UP IMMUNITY. CURRENT METHODS OF FABRICATING SOI MATERIAL RESULT IN EITHER COST

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AND/OR QUALITY PROBLEMS. THE ZMR PROCESS OFFERS AN ALTERNATIVE TO  
OTHER SOI PROCESSES.

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CONTRACT NUMBER:  
PAUL ZAVRACKY  
TITLE:  
SILICON ON INSULATOR FILMS PREPARED BY ZONE-MELTING-  
RECRYSTALLIZATION DEVICE MODELING  
TOPIC# 14 OFFICE:

THERE IS A NEED FOR MODELS TO PREDICT THE PROPERTIES OF DEVICES  
PRODUCED USING SILICON ON INSULATOR (SOI) SUBSTRATES. A LARGE BODY OF  
WORK EXISTS TO MODEL DEVICES PRODUCED ON CONVENTIONAL SUBSTRATES, BUT  
IT IS NOT DIRECTLY APPLICABLE TO SOI SUBSTRATES. NONE OF THE MODELS  
HAVE PROVISIONS FOR INCORPORATING THE SILICON THICKNESS, OXIDE  
THICKNESS OR OXIDE INTERFACE CHARGE BELOW THE ACTIVE DEVICE. THIS  
TYPE OF MODELING INFORMATION IS NECESSARY TO DESIGN PROCESSES FOR  
INTEGRATED CIRCUIT PRODUCTION, ESTABLISH DESIGN RULES FOR LAYOUT AND  
SPECIFY RELIABILITY LIMITS ON THE MATERIAL. WORKING MODELS ARE BEING  
DEVELOPED FOR METAL OXIDE SEMICONDUCTOR DEVICES WITH GEOMETRIES DOWN  
TO 1.25 MICRON ON SOI MATERIAL. THE MODELS ARE BEING DESIGNED IN A  
MODULAR MANNER SO THAT THEY CAN BE INCORPORATED INTO FUTURE SIMULATION  
PROGRAMS. THE MODELS ARE TAKING STANDARD DOPING PROFILE INFORMATION  
AS THEIR INPUTS AND ARE OUTPUTTING THE STANDARD DEVICE PARAMETERS.  
THE RELATIONSHIP BETWEEN SUBSTRATE MATERIAL PROPERTIES AND THE DEVICE  
CHARACTERISTICS IS BEING ESTABLISHED. SOME SACRIFICES MAY BE MADE ON  
ABSOLUTE ACCURACY TO OBTAIN COMPUTER PROGRAMS WHICH WOULD EXECUTE  
RAPIDLY SO THAT MANY RUNS CAN BE MADE TO SIMULATE THE EFFECTS OF  
PROCESS VARIATIONS. SOI MATERIAL OFFERS MANY INHERENT ADVANTAGES OVER  
CONVENTIONAL SILICON BULK WAFERS: RADIATION HARDNESS, VOLTAGE  
ISOLATION, IMPROVED SPEED PERFORMANCE, GREATER PACKING DENSITY AND  
CERAMIC-METAL-OXIDE SEMICONDUCTOR LATCH-UP IMMUNITY.

KOPIN CORP  
695 MYLES STANDISH BLVD.  
TAUNTON, MA 02780  
CONTRACT NUMBER:  
RONALD P GALE  
TITLE:  
DUAL SUSCEPTOR ORGANOMETALLIC CHEMICAL VAPOR DEPOSITIO  
PRODUCTION OF HETEROSTRUCTURE MATERIALS  
TOPIC# 14 OFFICE:



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A PRODUCTION ORGANOMETALLIC CHEMICAL VAPOR DEPOSITION REACTOR IS BEING DESIGNED CAPABLE OF DEPOSITING UNIFORM AND ABRUPT LAYERS OF GaAs AND AlGaAs FOR THE NEXT GENERATION OF HETEROSTRUCTURE DEVICES. THESE INCLUDE HIGH ELECTRON MOBILITY STRUCTURES FOR BOTH DIGITAL AND MONOLITHIC MICROWAVE INTEGRATED CIRCUITS, AS WELL AS QUANTUM WELL STRUCTURES FOR OPTICAL COMMUNICATION. THIS DESIGN IS ANTICIPATED TO OBTAIN THE NECESSARY CONTROLS OVER THICKNESS AND UNIFORMITY SIMILAR TO THAT OF MOLECULAR BEAM EPITAXY. THE DESIGN USES TWO SUSCEPTORS AND AN UPWARD FLOW TO SIMPLIFY THE GAS FLOW IN THE DEPOSITION ZONE. A PROTOTYPE REACTOR HAS BEEN CONSTRUCTED AND IS CURRENTLY IN USE. EXPERIMENTS ARE BEING CONDUCTED TO EVALUATE REACTOR PARAMETERS AND DETERMINE WHICH ONES ARE CRITICAL TO SCALE-UP OF THE SYSTEM. ADDITIONAL EXPERIMENTS ARE BEING DESIGNED AND, BASED ON THE UP-TO-DATE RESULTS OF THE PROTOTYPE, THE REACTOR DESIGN IS BEING EVALUATED FOR USE IN PRODUCTION. THE SUCCESS OF THIS PROJECT WILL LOWER THE COST AND INCREASE THE PRODUCTION THROUGHPUT FOR MATERIALS REQUIRED IN THE NEXT GENERATION OF GaAs DEVICES.

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PO BOX 368  
AMHERST, MA 01004  
CONTRACT NUMBER:  
DR J R KITTRELL  
TITLE:  
HIGHLY ENERGETIC CAST-CURED PROPELLANT BINDER  
TOPIC# 6                      OFFICE:

AN ENERGETIC BINDER CAPABLE OF USE IN THE EXISTING CAST-CURE MANUFACTURING PROCESS FOR PROPELLANTS OFFERS SUBSTANTIAL NEAR-TERM OPPORTUNITIES FOR FORMULATION OPTIMIZATION IN ORDER TO SUBSTANTIALLY INCREASE ENERGY DENSITY, WHILE MAINTAINING MECHANICAL PROPERTIES, STABILITY, AND SAFETY. THE CAST-CURE PROCESS IS PARTICULARLY SUITABLE FOR SOLID PROPELLANT AND EXPLOSIVE SYSTEMS DUE TO ITS UTILITY IN THE MANUFACTURE OF VERY LARGE PROPELLANT CHARGES AND COMPLEX GEOMETRIES. AN EXISTING, COMMERCIALY AVAILABLE CAST-CURE BINDER (HYDROXYL TERMINATED POLYBUTADIENE, HTPB) CAN BE NITRATED IN A SIMPLE, ONE-STEP PROCESS WITHOUT DELETERIOUS EFFECT ON THE PROPERTIES OF THE CURED ELASTOMER. THE CURRENT LIMITATIONS ON DEGREE OF NITRATION ARE BEING EXTENDED; ENERGETIC AND COMPATIBILITY PROPERTIES CONFIRMED; AND CURING

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AND FORMULATION PROPERTIES OPTIMIZED. THE RESULT, IF SUCCESSFUL, WOULD BE A SYSTEM CAPABLE OF PRODUCING AN ENERGETIC BINDER WHICH EXPLOITS BOTH A COMMERCIALY AVAILABLE POLYMERIC BINDER (HTPB) AND THE CURRENTLY USED CAST-CURE PROPELLANT MANUFACTURING PROCESS.

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ALBUQUERQUE, NM 87110  
CONTRACT NUMBER:  
DR D V KELLER  
TITLE:  
DYNAMIC EXPANSION ADIABAT IN THE TWO-PHASE LIQUID/VAPO  
TOPIC# 9                      OFFICE:

EQUATION-OF-STATE DATA IN THE MIXED VAPOR/LIQUID REGION IS BEING MEASURED. USE OF PULSED RELATIVISTIC ELECTRON BEAMS IS BEING USED TO RAPIDLY HEAT MATERIALS AT CONSTANT VOLUME. UPON DYNAMIC STRESS RELIEF THROUGH ISENTROPIC EXPANSION, THE MATERIAL IS BEING MADE TO PASS THROUGH THE STEAM DOME INTO THE MIXED LIQUID/VAPOR REGION. MEASUREMENT OF THE RESULTANT MATERIAL STRESS HISTORY COULD PROVIDE INFORMATION ON THE SHAPE OF THE DYNAMIC RELEASE ISENTROPE THROUGH THE MIXED LIQUID/VAPOR REGION. THIS BEHAVIOR HAS NOT BEEN MEASURED PREVIOUSLY BECAUSE OF EXPERIMENTAL DIFFICULTIES IN THE ONLY PREVIOUS TECHNIQUE, NAMELY, HYPERVELOCITY IMPACT STUDIES. THIS EXPANSION EQUATION-OF-STATE MEASUREMENT COULD BE MADE ON MOST MATERIALS OF INTEREST USING PROVEN TECHNIQUES AND EXISTING ELECTRON BEAM GENERATORS. THE PRINCIPAL BENEFIT IS THE ABILITY TO MEASURE AN IMPORTANT PROPERTY OF MATERIAL DYNAMIC BEHAVIOR NOT PREVIOUSLY ACCESSIBLE.

KTECH CORP  
901 PENNSYLVANIA NE  
ALBUQUERQUE, NM 87110  
CONTRACT NUMBER:  
T J ROEMER  
TITLE:  
SIMULTANEOUS MEASUREMENT OF MASS LOSS AND IMPULSE IN L  
STUDIES  
TOPIC# 8                      OFFICE:

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RECENT MEASUREMENTS OF MASS LOSS IN PULSED LASER-TARGET INTERACTION STUDIES HAVE BEEN UNSUCCESSFUL FOR NON-METALLIC MATERIALS. THIS IS DUE TO THE GAIN OR LOSS OF MASS, PRESUMBLY DUE TO ABSORPTION OR DESORPTION, BETWEEN THE TIME OF FIRST WEIGHING, THE TARGET INTERACTION, AND THE SECOND WEIGHING. A NEW INSTRUMENT IS BEING DEVELOPED THAT CAN MAKE THE MEASUREMENT THROUGH THE IRRADIATION WITH A SUB-SECOND RESOLUTION TIME AND WITHOUT HANDLING THE SAMPLE OR REMOVING IT FROM A VACUUM TEST CHAMBER. IN ADDITION, THIS TOTAL IMPULSE DELIVERED BY THE BLOW-OFF MATERIAL CAN BE MEASURED SIMULTANEOUSLY. THIS INSTRUMENT WOULD PROVIDE A RELIABLE MEANS OF MEASURING ABLATIVE MASS LOSS IN LASER-TARGET INTERACTION STUDIES, ESPECIALLY FOR NON-METALLIC MATERIALS. CONSIDERABLE INCREASE IN EFFICIENCY OF USING EXPENSIVE, HIGH-POWER LASERS WOULD RESULT AND IT COULD BE USED EFFECTIVELY FOR PARTICLE BEAM/TARGET MASS STUDIES.

L.N.K CORP INC  
6811 KENILWORTH AVE - STE 306  
RIVERDALE, MD 20737  
CONTRACT NUMBER:  
THOMAS TSAO  
TITLE:  
COMPUTER ARCHITECTURE AND VERY HIGH-LEVEL LANGUAGE DES  
FOR BATTLE MANAGEMENT  
TOPIC# 10                      OFFICE:

CURRENT COMPUTATIONAL APPROACHES ARE INADEQUATE TO PERFORM REAL TIME PATTERN RECOGNITION AND ADAPTIVE RESOURCE ALLOCATION IN ORDER TO SUITABLY RESPOND TO ENEMY THREATS WHEN COMPARED TO THE DYNAMICALLY CHANGING MILITARY ENVIRONMENTS. DESPITE DECADES OF EFFORT BASED UPON STATISTICAL SIGNAL PROCESSING AND PATTERN RECOGNITION METHODOLOGY, THE REAL TIME RECOGNITION OF COMPLEX TARGETS REMAINS A CHALLENGING PROBLEM. IN THE AREA OF BATTLEFIELD SITUATION ASSESSMENT, THERE DOES NOT APPEAR TO BE A SUITABLE APPROACH TO RESPOND TO THE COMPLEX DYNAMICALLY EVOLVING SCENARIO THAT SUCH ASSESSMENT AND ALLOCATION PROBLEMS REQUIRE. THE FEASIBILITY IS BEING EXAMINED OF DESIGNING A CONTINUOUS REAL TIME PATTERN RECOGNITION AND THREAT RESPONSE CAPABILITY IN DYNAMICALLY CHANGING MILITARY ENVIRONMENTS USING THE INNOVATIVE APPROACH OF A COMPUTATIONAL PERCEPTUAL PROCESS BASED ON A COGNITIVE NET. THIS STUDY PROVIDES AN OPPORTUNITY TO ATTACK VERY

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SIGNIFICANT DEFENSE PROBLEMS THAT HAVE LONG AWAITED PRACTICAL SOLUTIONS BY INTEGRATING IDEAS AND METHODOLOGIES DERIVED FROM COGNITIVE SCIENCE, NEURAL NET MODELING, PATTERN RECOGNITION, ARTIFICIAL INTELLIGENCE, AND NOVEL COMPUTATIONAL ARCHITECTURES USING CURRENTLY DEVELOPING TECHNIQUES SUCH AS VERY LARGE SCALE INTEGRATION.

LJF CORP  
411 S LONDON AVE  
EGG HARBOR, NJ 08215  
CONTRACT NUMBER:  
JAMES L FOY  
TITLE:  
INFRARED MISSILE DEFENSE SENSOR EVALUATION  
TOPIC# 3                      OFFICE:

IN DEVELOPING BALLISTIC MISSILE SENSORS, A MEANS OF GENERATING SYNTHETIC TEST PATTERNS IS ESSENTIAL. HOWEVER, IT IS NEARLY IMPOSSIBLE WITH BALLISTIC MISSILE DEFENSE SYSTEMS TO SET UP FIELD TESTS TO SIMULATE BATTLE CONDITIONS. EXPERIENCE HAS SHOWN THAT THE COMPLEXITIES OF THE NATURAL ENVIRONMENT ARE NOT MODELED ADEQUATELY BY WHOLLY SYNTHETIC IMAGES SO THAT THEY PROVIDE A COMPREHENSIVE EVALUATION OF A SYSTEM. THERE IS A RECOGNIZED NEED ALSO FOR REPEATABLE IMAGERY OF NATURAL SCENES, THAT IS, IMAGERY THAT HAS BEEN RECORDED, AND CAN BE REPRODUCED REPEATEDLY IN A CONSISTENT FASHION WHILE RETAINING THE SAME RADIOMETRIC ATTRIBUTES. THUS, THERE IS A NEED FOR A NEW APPROACH OR DEVICE FOR TESTING AND EVALUATING ADVANCED INFRARED SENSORS USED IN SPACE-BASED BALLISTIC MISSILE DEFENSE SYSTEMS. A VIDEO-TO-PHOTON CONVERTER IS BEING INVESTIGATED THAT OPERATES IN THE MID TO THE FAR INFRARED SPECTRUM. THIS DEVICE IS A CATHODE RAY TUBE-LIKE DEVICE WITH A SPECIAL TARGET SUBSTRATE THAT HAS THE CAPABILITY OF EMISSIONS IN ALL OF THE WAVEBANDS OF INTEREST. A MEANS TO VARY THE SPECTRAL RESPONSE IS BEING PROVIDED. DELTA T'S OF OVER ONE THOUSAND DEGREES C WITH BACKGROUND TEMPERATURES CONTROLLABLE FROM 20K TO HUNDREDS OF DEGREES K ARE ANTICIPATED. RESOLUTION IS EXPECTED TO BE COMPARABLE TO THAT OF HIGH RESOLUTION VIDEO MONITORS.

MAGMA-SEAL INC  
10116 ASPEN ST  
AUSTIN, TX 78758  
CONTRACT NUMBER:  
DR EARL T DUMITRU  
TITLE:  
PERFLUOROETHER ELASTOMERIC SEALS VIA DIRECT FLUORINATI  
TOPIC# 13                      OFFICE:

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LOW TEMPERATURE DYNAMIC SEALS WITH GOOD FIRE RESISTANCE AND CHEMICAL STABILITY ARE REQUIRED IN SPACE STRUCTURES SUCH AS ROCKET BOOSTERS. CONVENTIONAL METHODS OF CROSSLINKING AND CURING PERFLUOROETHER FLUIDS HAVE PROVED VERY DIFFICULT AND COSTLY TO APPLY TO THE PRODUCTION OF PERFLUOROETHER ELASTOMERS. DIRECT FLUORINATION METHODS ARE BEING APPLIED TO NOVEL, CROSSLINKED POLYETHERS WHICH ARE BEING CONVERTED TO THE CORRESPONDING PERFLUOROETHER ELASTOMERS WITH F2 GAS. SUCCESS DEPENDS ON FINDING NEW CO-AGENTS WHICH PROVIDE HOMOGENEOUS CARBON-CARBON CROSSLINKS IN THE SUBSTRATE HYDROCARBON ETHER BEFORE FLUORINATION, AND WILL SURVIVE F2 TREATMENT TO YIELD FLUORINATED STRUCTURES. REACTION CONDITIONS ARE BEING FORMULATED WHERE POTENTIAL CO-AGENTS SUCH AS DIVINYL ETHERS CAN GRAFT TO AND CROSSLINK POLYETHERS BY FREE-RADICAL REACTIONS OR RADIATION. THE SUITABILITY IS BEING EXPLORED OF FILLERS SUCH AS VARIOUS CARBON-BLACKS TO ENHANCE THE PHYSICAL PROPERTIES OF THE CURED POLYMERS. THE MOLECULAR WEIGHT AND COMPOSITION OF THE POLYETHER STARTING MATERIALS ARE BEING OPTIMIZED TO ACHIEVE THE DESIRED PARAMETERS. FLUORINATION CONDITIONS ARE BEING IDENTIFIED THAT WILL YIELD PERFLUORINATED ELASTOMERIC PRODUCTS WITH GOOD PHYSICAL PROPERTIES. ORINGS ARE BEING PREPARED FROM BOTH TYPES OF POLYMER BACKBONES AND THEIR PROPERTIES CHARACTERIZED SO THAT A COST-EFFECTIVE DECISION CAN BE MADE ON THEIR USEFULNESS.

MAINSTREAM ENGINEERING CORP

6191 ANCHOR LN

ROCKLEDGE, FL 32955

CONTRACT NUMBER:

DR R P SCARINGE

TITLE:

TWO-PHASE THERMAL TRANSPORT SIMULATION PROGRAM FOR  
SPACECRAFT APPLICATIONS

TOPIC# 4                      OFFICE:

FUTURE MILITARY SPACE MISSIONS WILL INTRODUCE SIGNIFICANT NEW TECHNOLOGICAL NEEDS FOR SPACECRAFT ENERGY SYSTEMS. VARIOUS TECHNOLOGIES NEED TO BE EVALUATED TO DETERMINE THE BEST TECHNOLOGY FOR A PARTICULAR APPLICATION. A DESIGN TOOL THAT ALLOWS RAPID BUT ACCURATE COMPARISON OF ALL ALTERNATIVES WOULD BE EXTREMELY USEFUL. A GENERALIZED TWO-PHASE TRANSIENT MODELING CAPABILITY IS BEING DEVELOPED THAT WILL ENHANCE THE PREDICTION OF TWO-PHASE THERMAL MANAGEMENT

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DESIGN ALTERNATIVES, COMPONENT FAILURES, AND SYSTEM SURVIVABILITY AND MAINTAINABILITY. DEVELOPMENT AND DEMONSTRATION OF THE CAPABILITY AND FLEXIBILITY OF A GENERAL TWO-PHASE FLUID FLOW SIMULATOR IS ANTICIPATED TO RESULT FROM THE INVESTIGATION. THE SIMULATOR REPRESENTS A NATURAL EVOLUTION OF A CURRENT SINGLE-PHASE SIMULATOR AND IS EXPECTED TO ALLOW ARBITRARY FLUID/THERMAL SYSTEM CONFIGURATIONS EMPLOYING ANY OF ELEVEN SPACECRAFT COMPONENT MODELS BEING DEVELOPED UNDER THIS EFFORT. TWO-PHASE FLUID PROPERTIES FROM THE LITERATURE ARE BEING EMPLOYED TO CREATE A SATURATED AND SUPERHEATED LIBRARY FOR REFRIGERANT-11.

MAINSTREAM ENGINEERING CORP

6191 ANCHOR LANE

ROCKLEDGE, FL 32955

CONTRACT NUMBER:

DR R P SCARINGE

TITLE:

HEAT PUMP AUGMENTED SPACECRAFT HEAT REJECTION SYSTEM

TOPIC# 7

OFFICE:

FUTURE MILITARY SPACE MISSIONS WILL INTRODUCE SIGNIFICANT NEW TECHNOLOGICAL NEEDS FOR SPACECRAFT ENERGY SYSTEMS. HEAT PUMP AUGMENTED SPACECRAFT HEAT REJECTION SYSTEMS HAVE THE POTENTIAL TO REDUCE RADIATOR SIZE AND SYSTEM WEIGHT. VAPOR-COMPRESSION HEAT PUMP RADIATOR CONFIGURATIONS FOR SPACECRAFT HEAT REJECTION SYSTEMS ARE BEING INVESTIGATED. CONVENTIONAL HEAT PUMP COMPONENTS THAT MUST BE REDESIGNED FOR ZERO-GRAVITY OPERATION ARE BEING HIGHLIGHTED WITH PRELIMINARY MODIFICATIONS IDENTIFIED. SEVERAL VAPOR-COMPRESSION HEAT PUMP CONFIGURATIONS INCLUDING MULTISTAGE HEAT PUMP PAIRS ARE BEING INVESTIGATED. IN ADDITION, SEVERAL THERMALLY DRIVEN HEAT PUMP CONCEPTS ARE BEING EXPLORED. NOVEL HEAT PUMP RELATED THERMAL ENERGY STORAGE AND TRANSPORT DESIGNS ARE ALSO BEING CONSIDERED. A CANDIDATE HEAT PUMP CONFIGURATION IS BEING PROPOSED FOR FURTHER ANALYSIS AND CONSTRUCTION DURING A LATER EFFORT.

MATERIALS MODIFICATIONS INC

2946 SLEEPY HOLLOW RD - STE 2H

FALLS CHURCH, VA 22044

CONTRACT NUMBER:

T S SUDARSHAN

TITLE:

SOLID LUBRICANTS FOR SPACE STRUCTURES

TOPIC# 13

OFFICE:

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NEW AND INNOVATIVE NONEQUILIBRIUM MATERIALS FOR VARIOUS SPACE STRUCTURES ARE NEEDED FOR STRATEGIC DEFENSE. ONE AREA WHERE LITTLE ATTENTION HAS BEEN FOCUSSED IS THE DEVELOPMENT OF SOLID LUBRICANTS. THE POTENTIAL USE IS BEING EXPLORED OF HIGH LEAD BEARING COPPER ALLOYS (UP TO 50% LEAD) AS BEARING MATERIALS; BATTERY GRIDS THAT WOULD REPLACE THE CURRENTLY USED LEAD ALLOYS; AND POSSIBLE COATINGS FOR HIGH FRICTION LOCATIONS IN SPACE STRUCTURES. UNDERSTANDING OF THE ADVANTAGES AND LIMITATIONS OF SOLID LUBRICANTS IN SPACE STRUCTURES IS BEING FACILITATED. AT A LATER PHASE, A COMPREHENSIVE PROGRAM COULD BE DEVELOPED TO BETTER UNDERSTAND THE BEHAVIOR OF THESE ALLOYS WITH A VIEW TOWARD PRODUCING COMPONENTS OR COATINGS FOR USE IN ACTUAL SPACE STRUCTURES FOR SUBSEQUENT EVALUATION. IT IS EXPECTED AFTER EXTENDED STUDIES THAT THESE HIGH LEAD BEARING ALLOYS COULD BE USED AS A SOLID LUBRICANT IN SEVERAL FRICTION RELATED APPLICATIONS IN SPACE OR SATELLITE STRUCTURES, AUTOMOTIVE FLEETS, AND IN BATTERIES IN SUBMARINES, TANKS, AND HEAVY DUTY MACHINERY.

MATERIALS SCIENCES CORP  
GWYNEDD PLAZA II - BETHLEHEM PIKE  
SPRING HOUSE, PA 19477  
CONTRACT NUMBER:  
DAVID J BARRETT  
TITLE:  
PASSIVE DAMPING CHARACTERISTICS OF SATELLITE STRUCTURA  
TOPIC# 12                      OFFICE:

THE DESIGNS PROPOSED FOR THE NEXT GENERATION OF ORBITAL SPACECRAFT CALL FOR LARGE BUT SLENDER STRUCTURAL FORMS WITH A LOW MASS DENSITY AND A RELATIVELY HIGH OVERALL FLEXIBILITY. SINCE THESE STRUCTURAL FORMS ARE PARTICULARLY SENSITIVE TO LOW AND HIGH FREQUENCY OPERATIONAL EXCITATIONS, IT IS IMPERATIVE THAT THESE STRUCTURES CONTAIN MECHANISMS FOR SUPPRESSING VIBRATIONS THROUGH ACTIVE CONTROL SYSTEMS AND THROUGH PASSIVE ENERGY DISSIPATION. ONE APPROACH TO PASSIVE STRUCTURAL DAMPING INVOLVES A COMPOSITE DESIGN WHICH COMBINES TOGETHER AND EFFICIENTLY UTILIZES STIFFNESS AND DAMPING MATERIALS. THIS IS BEING ACCOMPLISHED BY EXPLOITING THE STRESS COUPLING OF AN ANISOTROPIC CONSTRUCTION SUCH AS TO PROVIDE FOR AN INTENSE SHEARING OF THE DAMPING MATERIAL. THE RESULTING STRUCTURAL COMPONENT WITH SUPERIOR DAMPING PROPERTIES WOULD HAVE SIGNIFICANT VALUE TO THE STRATEGIC DEFENSE

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EFFORT. AN APPROPRIATE STRUCTURAL THEORY IS BEING FORMULATED FOR THE STUDY OF AXIAL-TORSIONAL VIBRATIONS IN THE NEW DESIGN. A SOLUTION PROCEDURE AND A NUMERICAL ALGORITHM IS BEING DEVELOPED FOR STUDYING THE NEW DESIGN. PARAMETRIC STUDIES ARE BEING PERFORMED ON A BASIC (A SET OF INNER AND OUTER CONCENTRIC CYLINDERS) AND AN ADVANCED (MULTIPLE CONCENTRIC CYLINDERS) FORM OF THE NEW DESIGN. OTHER ASSOCIATED DESIGN CONSIDERATIONS (CONNECTIONS, DIMENSIONAL STABILITY, SURVIVABILITY) ARE BEING IDENTIFIED AND EXAMINED.

MICRILOR INC  
NINE LAKESIDE OFFICE PARK  
WAKEFIELD, MA 01880  
CONTRACT NUMBER:  
DR IWEN YAO

TITLE:  
INCOHERENT RADAR IMAGING OF UNCOOPERATIVE TARGETS  
TOPIC# 3                      OFFICE:

SIMILARITY BETWEEN COMPUTER-AIDED TOMOGRAPHY (CAT) AND SYNTHETIC APERTURE RADAR (SAR) HAS ONLY RECENTLY BEEN RECOGNIZED. BASED ON THE TOMOGRAPHIC INTERPRETATION OF SAR, IT IS POSSIBLE TO IGNORE THE COHERENCY NORMALLY ASSUMED IN RADAR IMAGING AND CONFIGURE AN INCOHERENT (OR BASEBAND) RADAR IMAGING SYSTEM. THE INCOHERENT RADAR SYSTEM WOULD THEN HAVE ADVANTAGES OF ELIMINATING THE SPECKLE PROBLEM AND RELAXING THE SYSTEM STABILITY REQUIREMENTS. ELIMINATION OF THE SPECKLE PROBLEM WOULD GREATLY ENHANCE THE CLARITY OF TARGET IMAGES AND, THEREFORE, HELP SOLVE THE TARGET-DISCRIMINATION PROBLEMS OF BALLISTIC MISSILE DEFENSE SYSTEMS. THIS INNOVATIVE INCOHERENT RADAR IMAGING CONCEPT IS BEING INVESTIGATED. INCOHERENT RADAR IMAGING ALGORITHM IS BEING DEVELOPED BASED ON THE TOMOGRAPHIC INTERPRETATION OF SYNTHETIC APERTURE. SYSTEM STUDY IS BEING PERFORMED IN THE CONTEXT OF STRATEGIC DEFENSE REQUIREMENTS LEADING TO A PERFORMANCE REQUIREMENT FOR THE RADAR IMAGING PROCESSOR. PROCESSOR ARCHITECTURE IS BEING STUDIED AND POTENTIAL PROCESSING TECHNOLOGIES SURVEYED. THE CONCEPT, IF FEASIBLE, WOULD PROVIDE SIGNIFICANT ENHANCEMENT IN THE IMAGE QUALITY OF RADAR IMAGING SYSTEM. THE RESULT WOULD CONTRIBUTE SUBSTANTIALLY TO THE CREDIBILITY OF SENSOR CAPABILITIES. THIS CONCEPT CAN ALSO BE APPLIED TO THE OTHER TYPES OF IMAGING SYSTEMS SUCH AS SPOT-MAP SAR AND ULTRASONIC IMAGING SYSTEMS.



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MICROSCIENCE INC  
41 ACCORD PARK DR  
NORWELL, MA 02061  
CONTRACT NUMBER:  
DR OLEG POPOV  
TITLE:  
ELECTRON CYCLOTRON RESONANCE SOURCE FOR HIGH CURRENT H  
ION BEAMS  
TOPIC# 1                      OFFICE:

THE SUCCESSFUL PERFORMANCE OF THE CHARGED PARTICLE BEAMS IN BALLISTIC MISSILE DEFENSE SYSTEMS REQUIRES AN EFFICIENT ION SOURCE CAPABLE OF PRODUCING HIGH CURRENT HEAVY ION BEAMS STABLY OPERATING FOR HUNDREDS OF HOURS. CONVENTIONAL ION SOURCES USING THE HEATING FILAMENTS CAN OPERATE IN OXYGEN PLASMAS FOR ONLY A FEW HOURS. THE METHOD BEING UNDERTAKEN FOR ACHIEVING THIS GOAL IS THE MICROWAVE ION SOURCE UTILIZING THE ELECTRON CYCLOTRON RESONANCE (ECR). AN ECR PLASMA SOURCE IS BEING DESIGNED AND BUILT, AND ITS EXPERIMENTAL SET-UP IS BEING AIMED AT RESEARCHING PHENOMENON AND CHARACTERISTICS ASSOCIATED WITH THE ABSORPTION OF MICROWAVE POWER IN ECR PLASMAS RESULTING IN HIGH OXYGEN PLASMA DENSITIES. INCLUDED ARE THE EFFECTS OF MAGNETIC FIELD AND ITS AXIAL DISTRIBUTION ON THE LEVEL OF MICROWAVE POWER ABSORPTION AND ECR PLASMA DENSITY AND ITS SPATIAL DISTRIBUTION. OTHER CHARACTERISTICS BEING RESEARCHED ARE GEOMETRY AND LOCATION OF THE ABSORPTION AREA AND THEIR EFFECTS ON THE OPTIMUM SIZE OF THE ECR PLASMA CHAMBER.

MICROWAVE MONOLITHICS INC  
465 E EASY ST  
SIMI VALLEY, CA 93065  
CONTRACT NUMBER:  
DANIEL R CHEN  
TITLE:  
VERSATILE MILLIMETER-WAVE LOW NOISE MONOLITHIC GaAs FR  
SYNTHESIZER COMPONENT  
TOPIC# 14                      OFFICE:

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AN ADVANCED 60 GHZ MONOLITHIC SYNTHESIZER COMPONENT IS BEING DEVELOPED BASED ON SEVERAL RECENT BREAKTHROUGHS TO IMPLEMENT A TUNABLE LOW NOISE FREQUENCY SYNTHESIZER AT MILLIMETER-WAVE FREQUENCIES. SMALLER SIZE, INCREASED RELIABILITY, AND SIMPLIFIED MILLIMETER-WAVE RECEIVER/TRANSMITTER CONFIGURATIONS FOR APPLICATIONS SUCH AS SECURE 60 GHZ SATELLITE CROSSLINKS WOULD BECOME FEASIBLE AFTER DEVELOPMENT OF THIS KEY SUPER-COMPONENT. A LOW NOISE THREE TERMINAL ACTIVE DEVICE AND AN ON-CHIP FREQUENCY DIVISION APPROACH, BOTH COMPATIBLE WITH MONOLITHIC INTEGRATION ON GaAs SUBSTRATES, MAKE THIS TECHNICAL OBJECTIVE POSSIBLE. FEASIBILITY IS BEING DEMONSTRATED BY DETAILED DESIGN AND SIMULATION OF THE MONOLITHIC SUPER-COMPONENT, FOLLOWED BY FABRICATION AND SYNTHESIZER EVALUATION AT A LATER PHASE. THE 60 GHZ SYNTHESIZER COMPONENT WOULD PROVIDE ENHANCED PERFORMANCE AND RELIABILITY, SMALLER SIZE, AND POTENTIALLY LOWER COST. IN ADDITION, ADVANCES ACHIEVED WOULD ENHANCE THE STATE OF THE ART IN MILLIMETER-WAVE MONOLITHIC CIRCUIT TECHNOLOGY, THUS ALLOWING UTILIZATION IN AREAS NOT PRESENTLY CONSIDERED FEASIBLE DUE TO EITHER COST OR PERFORMANCE CONSIDERATIONS (E.G., AGILE SPACE-BASED COMMUNICATION SYSTEMS IMMUNE FROM GROUND-BASED JAMMING AND EAVESDROPPING).

MICROWAVE MONOLITHICS INC

465 E EASY ST  
SUN VALLEY, CA 93065

CONTRACT NUMBER:

ROBERT D FAIRMAN

TITLE:

LOW TEMPERATURE ACTIVATION OF ION IMPLANTED COMPOUND S

TOPIC# 14                      OFFICE:

ION IMPLANTATION TECHNOLOGY HAS BEEN SHOWN TO BE THE LEADING FABRICATION METHOD FOR HIGHLY UNIFORM DOPING OF SEMICONDUCTORS. HOWEVER, SEVERAL PROBLEMS IN ION IMPLANTATION NOW HINDER THE PROGRESS OF GaAs INTEGRATED CIRCUITS WITH THE OVERALL EFFECT OF REDUCED YIELDS. THE PRESENT RESTRICTIONS IN III-V ION IMPLANTATION IS INADEQUATE REMOVAL OF ION BOMBARDMENT DAMAGE AND ITS SUBSEQUENT EFFECT UPON DAMAGE ENHANCED DIFFUSION AND REDUCED CARRIER ACTIVATION. THE FEASIBILITY IS BEING EXPLORED OF ACTIVATING ION IMPLANTED CARRIERS IN GaAs THROUGH A LOW TEMPERATURE REGROWTH OF AMORPHOUS LAYERS. SPECIAL

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TECHNIQUES ARE BEING USED FOR PRE-AMORPHIZING GaAs TO PREVENT DYNAMIC ANNEALING EFFECTS THAT OCCUR DURING ION BOMBARDMENT RESPONSIBLE FOR IRREVERSIBLE LATTICE DAMAGE. THE LOW TEMPERATURE REGROWTH TECHNIQUE OF THE AMORPHOUS LAYER IN THIS RESEARCH PROGRAM WOULD VIRTUALLY ELIMINATE THE LATTICE DEFECTS NORMALLY ASSOCIATED WITH ION BOMBARDMENT IN GaAs. BENEFITS OF THIS METHOD WOULD IMPROVE BOTH DISCRETE AND INTEGRATED CIRCUIT FABRICATION YIELD. FEASIBILITY OF NEW DEVICES FROM MODULATION DOPED AlGaAs USING HEAT EXCHANGER METHOD TECHNOLOGY AND Ge/GaAs MATERIALS WOULD BE POSSIBLE DUE TO NEW LOW TEMPERATURE PROCESSING TECHNIQUES. THE COMMERCIAL CONSEQUENCES OF THIS LOW TEMPERATURE ANNEAL METHOD ARE COST REDUCTIONS, YIELD ENHANCEMENT AND GREATLY IMPROVED MANUFACTURABILITY.

MISSION RESEARCH CORP  
PO DRAWER 719  
SANTA BARBARA, CA 93102  
CONTRACT NUMBER:  
C DAVID NEWLANDER  
TITLE:  
COUNTERMEASURE DEVELOPMENT FOR DECOY CREDIBILITY  
TOPIC# 3                      OFFICE:

PENETRATION AIDS (OR DECOYS) MUST REACH THEIR TARGETS WITH AN ACCEPTABLE PROBABILITY OF SURVIVAL AND REMAIN CREDIBLE UNDER BENIGN REENTRY CONDITIONS AND AFTER EXPOSURE TO HOSTILE ENVIRONMENTS FROM AN ATTACK BY ANTIBALLISTIC MISSILE (ABM) SYSTEMS. CURRENT COUNTERMEASURE CONCEPTS EMPLOYED FOR REENTRY VEHICLE (RV) DECOYS ARE AIMED PRIMARILY AT REDUCING THE MAGNITUDE AND EFFECT OF SURFACE IMPULSE LOADS INDUCED BY LOW ENERGY RADIATION EXPOSURES FROM CONVENTIONAL AND DIRECTED WEAPONS. EXISTING AND MORE ADVANCED INNOVATIVE ANTI-DISCRIMINATION APPROACHES NEED TO BE EVALUATED FOR THEIR EFFECTIVENESS UNDER VARIED THREAT SCENARIOS. SELECTED THREAT SCENARIOS ARE BEING DEVELOPED AND ANALYZED AS ARE DECOY RESPONSES TO THESE THREATS. ANTI-DISCRIMINATION CONCEPTS ARE BEING FORMULATED TO ENHANCE THE CREDIBILITY OF RV DECOYS FOLLOWING EXPOSURE TO RADIATION ENVIRONMENTS FROM SELECTED ANTIBALLISTIC MISSILE ABM SYSTEMS. EFFECTIVENESS AND COMPATIBILITY OF THESE CONCEPTS WITH DECOY DESIGNS AND NON-SURVIVABILITY-RELATED PERFORMANCE REQUIREMENTS IS BEING DETERMINED. PROVEN ANALYTICAL TECHNIQUES ARE BEING EMPLOYED TO CALCULATE THE CRITICAL RESPONSES OF

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RVS AND DECOYS DURING AND AFTER EXPOSURE TO RADIATION ENVIRONMENTS  
FROM SELECTED ABM THREATS. SUCCESSFUL DEVELOPMENT OF THIS  
ANTI-DISCRIMINATION CONCEPT WILL ENHANCE THE CREDIBILITY OF REENTRY  
VEHICLE DECOYS AFTER EXPOSURE TO RADIATION ENVIRONMENTS.

MISSION RESEARCH CORP  
PO DRAWER 719  
SANTA BARBARA, CA 93102  
CONTRACT NUMBER:  
DR STEVE F STONE

TITLE:  
DEGRADATION OF HARDENING CONCEPT PERFORMANCE DUE TO MU  
HYPERVELOCITY IMPACTS AND THERMAL PULSES  
TOPIC# 9                      OFFICE:

AN ANALYTICAL METHODOLOGY IS BEING DEVELOPED THAT IS CAPABLE OF  
DETERMINING THE OPTIMUM COMBINATION OF TEMPORALLY/SPATIALLY  
DISTRIBUTED PULSED-LASER AND HYPERVELOCITY IMPACTS NEEDED TO CAUSE  
SEVERE DAMAGE TO POSTULATED MULTITHREAT, MULTILAYER STRATEGIC ASSET  
STRUCTURES AND STRUCTURAL HARDENING CONCEPTS. THE METHODOLOGY ALSO  
WOULD ALLOW THE THEORETICAL DETERMINATION OF HARDENING CONCEPT  
MODIFICATIONS WHICH WOULD INCREASE THEIR RESISTANCE TO SUCH REPEATED  
PULSING. ANALYSIS HAS INDICATED THAT THE THERMAL/MECHANICAL IMPEDANCE  
MISMATCHES AND LOW MECHANICAL STRENGTH INHERENT IN SUCH HARDENING  
CONCEPTS COULD BE EXPLOITED BY PROPER TIMING/SPACING OF CANDIDATE  
DEW/KEW SOURCES, THUS GREATLY REDUCING THE INCIDENT ENERGY  
REQUIREMENTS. DELAMINATIONS COULD BE CREATED AND CAUSED TO PROPAGATE  
LEADING TO GREATLY REDUCED HARDENING CONCEPT AND UNDERLYING STRUCTURE  
PERFORMANCE. EFFORTS TO DATE HAVE IGNORED MUCH OF THE PHENOMENOLOGY  
ASSOCIATED WITH SUCH SCENARIOS RESULTING IN QUESTIONABLE LETHALITY AND  
HARDENING ESTIMATES. NOVEL ANALYTICAL METHODS ORIGINALLY DEVELOPED TO  
ADDRESS FLAW COALESCENCE PROBLEMS ARE BEING EMPLOYED TO ADDRESS THE  
DEVELOPMENT, GROWTH AND INTERACTION OF INITIALLY SUBCRITICAL  
STRUCTURAL AND HARDENING CONCEPT DAMAGE.

MISSION RESEARCH CORP  
PO DRAWER 719  
SANTA BARBARA, CA 93102  
CONTRACT NUMBER:  
ROBERT D EISLER  
TITLE:  
OPTICAL SENSORS FOR DISCRIMINATION AND BULK FILTERING  
REENTRY VEHICLES IN THREAT SWARMS  
TOPIC# 3                      OFFICE:

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CURRENT STRATEGIES TO DISCRIMINATE REENTRY VEHICLES (RVS) IN "THREAT SWARMS" RELY ON THE DEFENSE'S ABILITY TO IDENTIFY FEATURES BELIEVED OR OBSERVED TO BE ASSOCIATED WITH THREATENING RVS AND NOT WITH DEPLOYED DECOYS. THESE DISCRIMINATION STRATEGIES HAVE MANY PITFALLS. A DISCRIMINATION METHODOLOGY EMPLOYING COMPOSITE DISCRIMINANTS IS BEING DEVELOPED THAT UTILIZE RELATIONAL PROPERTIES BETWEEN CLASSES OF RVS AND CLASSES OF DECOYS. AS OPPOSED TO REFERENCING APRIORI INFORMATION ON RV FEATURES AND COMPARING FEATURES WITH AN INCOMING THREAT, CONSTRAINTS IN RV DESIGN ARE BEING DETERMINED THAT RESULT IN SETS OF FEATURES WHICH CANNOT BE SIMULTANEOUSLY MATCHED BY A DECOY AND MAINTAIN DECOY EFFECTIVENESS. THERE ARE FOUR SUCH CONSTRAINTS: TARGET GEOMETRY, MASS PROPERTIES, TOTAL MASS, AND SURVIVABILITY CONSTRAINTS. THESE CONSTRAINTS ARE BEING UTILIZED TO DEVELOP JOINT DISTRIBUTIONS OF FEATURES WHICH SERVE TO IDENTIFY VERY RAPIDLY WHAT SETS OF OBJECTS IN THE INCOMING THREAT SWARM ARE NOT DECOYS. THIS METHODOLOGY COMPARES GROUPS OF OBJECTS AGAINST EACH OTHER IN THREAT SWARMS. EXCURSIONS FROM JOINT DISTRIBUTION STATISTICS ASSOCIATED WITH THE COMPOSITE DISCRIMINANTS ARE BEING UTILIZED TO IDENTIFY WHAT CLASSES OF OBJECTS ARE NOT RVS AS OPPOSED TO REFERENCING AN APRIORI DATABASE FOR SIGNATURE ANALYSIS AND SUBSEQUENT RV IDENTIFICATION.

MISSION RESEARCH CORP  
PO DRAWER 719  
SANTA BARBARA, CA 93102  
CONTRACT NUMBER:  
C DAVID NEWLANDER  
TITLE:  
REDUCED THERMOSHOCK EFFECTS IN ELECTRONIC DEVICES  
TOPIC# 8                      OFFICE:

BECAUSE OF THE LARGE NUMBER OF INTEGRATED CIRCUIT DEVICE AND SEMICONDUCTOR BONDS INVOLVED IN STRATEGIC DEFENSE SYSTEMS, THE FAILURE RATES WHEN EXPOSED TO THERMO-MECHANICAL SHOCK EFFECTS MUST BE EXTREMELY SMALL IN ORDER TO INSURE SYSTEM SURVIVABILITY. SINCE THE GENERAL METHOD FOR PROVIDING SUCH SURVIVABILITY IS TO SHIELD THE ELECTRONICS TO LOW DOSE LEVELS, THE WEIGHT PENALTY CAN BE SIGNIFICANT AND POTENTIALLY CAN DEGRADE OVERALL SYSTEM PERFORMANCE. A NEW APPROACH IS REQUIRED. THE POTENTIAL IS BEING EVALUATED FOR THE DEVELOPMENT OF ELECTRONIC PACKAGES WHICH POSSESS SIGNIFICANT

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IMPROVEMENTS IN HARDNESS TO THERMOMECHANICAL EFFECTS. THE ELECTRONIC PACKAGE CONCEPTS BEING DEVELOPED, WHICH COULD SIGNIFICANTLY REDUCE THE THERMOMECHANICAL SHOCK EFFECTS GENERATED IN THE ELECTRONIC DEVICES, ARE BASED UPON THE SELECTION OF STRESS WAVE COMPATIBLE ATTACHMENT AND SUBSTRATE MATERIALS, AND AN OPTIMIZATION OF THE GEOMETRY AND THICKNESS BASED UPON THE THREAT ENVIRONMENT. ANALYSES ARE BEING CONDUCTED TO OPTIMIZE POTENTIAL PACKAGES AND MATERIALS, AND TESTS WITH ABOVEGROUND SIMULATORS ARE BEING PLANNED. THE SIMULATORS ARE BEING CAREFULLY SELECTED IN ORDER TO PROVIDE THE PROPER LOADING CONDITIONS AND TO PROVIDE AN EXPERIMENT OF HIGH FIDELITY.

MITCHELL/STIRLING MACHINES/SYSTEMS INC  
235 MONTGOMERY ST - 2700 RUSS BLDG  
SAN FRANCISCO, CA 94104  
CONTRACT NUMBER:  
MATTHEW P MITCHELL

TITLE:  
REVERSIBLE THERMODYNAMIC CYCLE PROTOTYPE FOR CRYOCOOLE  
APPLICATIONS  
TOPIC# 3                      OFFICE:

THE SIBLING CYCLE IS THE LIMITING CASE OF AN IDEAL STIRLING CYCLE. THE MACHINE THAT GENERATES THE CYCLE IS IN SOME RESPECTS SIMPLER THAN EXISTING STIRLING MACHINES. BECAUSE THE SIBLING CYCLE CAN OPERATE HIGH COMPRESSION RATIOS, AND THUS LARGE TEMPERATURE EXCURSIONS IN THE EXPANSION SPACE, IT HAS GREAT PROMISE IN CRYOCOOLER APPLICATIONS. TO DATE, ONLY TWO PAPERS HAVE BEEN PUBLISHED ON THE THERMODYNAMIC CHARACTERISTICS OF THE SIBLING CYCLE. THEY DEAL ONLY WITH ENGINE APPLICATIONS OF THE CYCLE, IGNORING ITS POTENTIAL AS A HEAT PUMP OR REFRIGERATOR. ADEQUATE INVESTIGATION OF THE SIBLING CYCLE AS A REFRIGERATOR REQUIRES MORE SOPHISTICATED SIMULATIONS. THE PHASE 1 RESEARCH WILL OUTLINE A PROGRAM OF EXPLORATION USING A COMPUTER SIMULATION MODEL, AND IDENTIFY SOFTWARE AND HARDWARE THAT COULD BE ADAPTED TO CARRY IT OUT. IF THE POTENTIAL OF THE SIBLING CYCLE MACHINE AS A REFRIGERATOR CAN BE DEMONSTRATED, IT WILL HAVE WIDE APPLICATION IN CRYOCOOLERS FOR INFRARED SENSING DEVICES, COMPUTERS, SUPERCONDUCTING MAGNETS AND SIMILAR DEVICES.

MITECH INC  
1066 UPPER GULPH RD  
WAYNE, PA 19087  
CONTRACT NUMBER:  
KENT C MASSEY  
TITLE:  
PARAMETRIC LAUNCH VEHICLE ECONOMIC ANALYSIS  
TOPIC# 6                      OFFICE:

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THE KEY TO REDUCING THE HIGH COST OF USING SPACE IS LOWERING THE COST OF GETTING THERE. THERE ARE MANY TECHNOLOGICAL OPTIONS FOR IMPROVING EXISTING LAUNCH VEHICLES OR DEVELOPING NEW ONES. DETERMINING WHETHER AN IMPROVEMENT CAN BE JUSTIFIED TECHNICALLY IS MUCH EASIER, UNFORTUNATELY, THAN FINDING OUT WHETHER IT WILL EVER BE JUSTIFIED ECONOMICALLY. IT MAKES LITTLE SENSE TO PUT FEW FUNDS INTO IMPROVING A LAUNCH VEHICLE OR INTO DEVELOPING A WHOLE NEW LAUNCH SYSTEM IF THAT INVESTMENT CAN NEVER BE REPAID THROUGH LOWER OPERATING COSTS. A THOROUGH UNDERSTANDING OF THE ECONOMICS AND COST DRIVERS OF LAUNCH SYSTEMS MUST BE THE FIRST STEP TOWARD REDUCING THE COST OF ACCESS TO SPACE. FROM THIS UNDERSTANDING, THE DETERMINATION CAN BE MADE ON WHICH LAUNCH SYSTEM PARAMETERS CAUSE THE GREATEST VARIABILITY IN COST. THOSE ARE THE PARAMETERS WHERE INVESTMENTS SHOULD BE MADE IN IMPROVEMENTS, BECAUSE THAT IS WHERE THE GREATEST LEVERAGE EXISTS TO REDUCE COSTS. A PARAMETRIC MODEL OF THE ECONOMICS OF LAUNCH SYSTEMS HAS BEEN DEVELOPED THAT HAS PROVEN TO BE A VERY POWERFUL TOOL FOR UNDERSTANDING WHAT SUCH SENSITIVE PARAMETERS ARE. THIS STUDY IS APPLYING THIS MODEL TO QUESTIONS WHICH ARE OF INTEREST TO STRATEGIC DEFENSE SYSTEMS PLANNING. THREE ALTERNATIVE SYSTEMS ISSUES ARE BEING REVIEWED AND ONE IS BEING SELECTED FOR DETAILED APPLICATION OF THIS PARAMETRIC MODEL.

MULTI-ARC INC  
261 E FIFTH ST - A/D-7  
ST PAUL, MN 55101  
CONTRACT NUMBER:  
ARTHUR ANDERSON  
TITLE:  
THIN-FILM PROTECTIVE COATINGS FOR ELECTROMAGNETIC RAIL  
TOPIC# 2                      OFFICE:

A THIN, HARD COATING WITH HIGH TEMPERATURE STABILITY IS NEEDED TO PROTECT THE CONDUCTIVE RAILS USED IN RAIL GUN SYSTEMS FROM DAMAGE FROM THE HIGH ENERGY PLASMA GENERATED DURING FIRING. SIMILAR COATINGS ALSO ARE NEEDED TO PROTECT THE SURFACES OF MEG AMP SWITCHES AND MAY BE OF BENEFIT FOR PROTECTION OF THE PROJECTILE ITSELF. THE COATING TECHNOLOGY USED MUST BE CAPABLE OF DEPOSITING THIS TYPE OF COATING IN SINGLE OR MULTI-LAYERS AT A LOW PROCESS TEMPERATURE AND ACHIEVE EXCELLENT ADHESION AND A DESIRABLE MICROSTRUCTURE. UTILIZING THE

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CATHODIC ARC PHYSICAL VAPOR DEPOSITION (PVD) TECHNOLOGY, TWENTY-FOUR CONDUCTIVE RAILS ARE BEING COATED WITH SIX HIGH TEMPERATURE COATINGS AND TWO THICKNESSES (2 RAILS EACH) FOR TEST FIRING IN THE MARC-1 PLASMA UTILITY GUN. AN ANALYSIS OF THE COATINGS AFTER FIRING SHOULD INDICATE THE COATING PROPERTIES OF IMPORTANCE, DEMONSTRATE FEASIBILITY AND BEGIN TO ESTABLISH A DATA BASE FOR LATER WORK IN THIS FIELD. BASED ON INITIAL RESULTS, THE KEY COATING PROPERTIES NECESSARY FOR PROTECTION SHOULD BE IDENTIFIED, ALONG WITH THE MOST PROMISING COATING MATERIAL(S). WORK IN A LATER PHASE SHOULD IMPROVE THE PERFORMANCE ON THE MOST PROMISING CANDIDATE(S) LEADING TO A COATING AND COATING PROCESS SPECIFICATION AND EARLY AVAILABILITY OF COATINGS FOR USE.

MULTILAYER OPTICS & X-RAY TECHNOLOGY

7070 UNIVERSITY STA

PROVO, UT 84602

CONTRACT NUMBER:

BRYAN G PETERSON

TITLE:

CONSTRUCTING SOFT X-RAY MACH-ZENDER INTERFEROMETER

TOPIC# 1

OFFICE:

WITH THE INCREASING INTEREST IN HIGHLY IONIZED GASES FOR FUSION RESEARCH AND EFFORTS TO DEMONSTRATE AMPLIFIED SPONTANEOUS EMISSION IN THE SOFT X-RAY REGION, THERE IS A SIGNIFICANT NEED FOR BETTER UNDERSTANDING OF THE ATOMIC KINETICS OF PLASMAS. ONE WAY OF OBTAINING ACCURATE DATA ON SPECTROSCOPIC STATE POPULATIONS IS THROUGH ABSORPTION SPECTROSCOPY. WITH THE DEVELOPMENT OF MULTILAYERED X-RAY OPTICAL ELEMENTS, IT IS NOW POSSIBLE TO CONSIDER THE DEVELOPMENT OF AN INTERFEROMETER FOR OPERATION USING SOFT X-RAYS. THE FEASIBILITY IS BEING EVALUATED OF CONSTRUCTING A MACH-ZENDER INTERFEROMETER FOR PERFORMING SOFT X-RAY SPECTROSCOPIC MEASUREMENTS ON A PLASMA DEVICE. THE INTERFEROMETER IS BEING DESIGNED AND PROTOTYPES OF ALL NECESSARY OPTICAL ELEMENTS ARE BEING FABRICATED FOR TESTING AND EVALUATION. DEFINING METHODS OF OPTIMIZING SOFT X-RAY MULTILAYER PARAMETERS FOR OPERATION IN VARIOUS CONFIGURATIONS AND CONDITIONS, AND ADVANCING THE THEORY OF DESIGN AND OPERATION OF MULTILAYERED DEVICES IS EXPECTED TO GREATLY SIMPLIFY THE TASK OF DETERMINING THE OPTIMUM OPTICAL CONFIGURATION FOR PERFORMING THE DESIRED SPECTROSCOPIC MEASUREMENTS. THE RESULTING DEVELOPMENT OF A SOFT X-RAY INTERFEROMETER WILL GREATLY



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ENHANCE THE QUALITY OF INFORMATION OBTAINABLE REGARDING THE  
SPECTROSCOPIC STATE POPULATION IN HIGHLY IONIZED GASES.

NICHOLS RESEARCH CORP  
4040 S MEMORIAL PKWY  
HUNTSVILLE, AL 35802  
CONTRACT NUMBER:  
PATRICIA L ATHA  
TITLE:  
TARGET TRACKING AGAINST DEPRESSED TRAJECTORIES  
TOPIC# 3                      OFFICE:

IMPROVEMENTS ARE NECESSARY IN THE ACCURACY OF TRACKING DEPRESSED REENTRY VEHICLES AT LOW HARD EARTH ANGLES AND PERFORMING HANDOVER (TRANSFER OF THE ERROR ELLIPSOID AT THE SPECIFIED ALTITUDE) TO ANOTHER ACTIVE OR PASSIVE BALLISTIC MISSILE DEFENSE SENSOR AS WELL AS IN THE MINIMIZATION OF EFFECTS ON BALLISTIC MISSILE DEFENSE OPTICAL SYSTEMS. THIS IS ESPECIALLY TRUE WHEN THE EFFECTS ARE EVALUATED IN TERMS OF GEOMETRY AND SENSOR PARAMETERS, ANGULAR MEASUREMENT PRECISION, ROOT MEAN BIAS, TARGET FALSE ALARMS AND DATA LOSS COMPARED TO EXISTING TECHNIQUES WHEN THE TRAJECTORY IS DEPRESSED. A METHOD FOR RESOLVING THESE PROBLEMS IS BEING DEMONSTRATED. THE FEASIBILITY OF AN ADAPTIVE TRACKING FILTER UTILIZING POLARIZED WAVELENGTHS IS BEING DETERMINED AND CRITICAL SENSOR ISSUES AGAINST DEPRESSED TRAJECTORIES ARE BEING IDENTIFIED. SYSTEM RESPONSES FOR VARIOUS COMPONENTS OF A LAYERED DEFENSE FOR TARGET TRACKING AGAINST DEPRESSED TRAJECTORIES ARE BEING ESTABLISHED. ANALYSIS OF INFRARED SIGNATURES, POLARIZATION FROM DIRECTIONAL EMITTANCE OF HEATSHIELD MATERIALS, AND HANDOVER ERROR TO RADAR OR INTERCEPTOR FOR BALLISTIC MISSILE DEFENSE ARE BEING USED. AT A LATER PHASE, THE FILTER COULD BE DEMONSTRATED AND CONCEPTS AND TECHNIQUES PROVIDED FOR IMPROVING THE INFRARED SYSTEM FUNCTIONS OF ACQUIRING, TRACKING, HANDOVER, AND INTERCEPTING REENTRY VEHICLES TO THE SYNERGISMS OF DEPRESSED, MINIMUM ENERGY AND LOFTED TRAJECTORIES.

NICHOLS RESEARCH CORP  
4040 S MEMORIAL PKWY  
HUNTSVILLE, AL 35802  
CONTRACT NUMBER:  
DENNIS P FLEMING  
TITLE:  
LASER HOLOGRAPHIC TECHNIQUES  
TOPIC# 3                      OFFICE:

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THE TWO EXISTING METHODS OF IMAGING AVAILABLE TO LASER RADAR SYSTEMS FOR SPACE-BASED TARGET DISCRIMINATION EXHIBIT SERIOUS LIMITATIONS TO THEIR APPLICABILITY IN A REAL TIME SITUATION. THE ANGLE-ANGLE IMAGING METHOD PLACES A SEVERE STRAIN ON BEAM AGILITY AND POINTING ACCURACY REQUIREMENTS OF THE SYSTEM IN ORDER TO IMAGE SEVERAL TARGETS, AND REQUIRES VERY LARGE APERTURE OPTICS IN ORDER TO RESOLVE TARGETS ADEQUATELY. TO CORRECTLY SCALE THE IMAGES IN THE CROSS RANGE DIMENSION, THE RANGE-DOPPLER METHOD REQUIRES EITHER AN A PRIORI KNOWLEDGE OF, OR AN EXAMPLE OF, THE TARGETS' DYNAMICAL MOTION. A NEW LASTER IMAGING METHOD MAY HAVE SOME ADVANTAGES OVER THESE TWO METHODS. THIS METHOD IS BASED UPON THE WAVEFRONT RECONSTRUCTION TECHNIQUE EMPLOYED IN CONVENTIONAL OPTICAL HOLOGRAPHY. IN THIS INVESTIGATION, PHOTOGRAPHIC FILM IS BEING REPLACED WITH A SUITABLE ARRAY OF PHOTO DETECTORS AND RECONSTRUCTED WAVEFRONTS ARE BEING CALCULATED AND FOCUSED INTO IMAGES BY A DATA PROCESSOR. THE FEASIBILITY IS BEING ASSESSED OF THE PROPOSED IMAGING METHOD, AND A PRELIMINARY DESIGN OF A SYSTEM IS BEING DEVELOPED THAT WILL IMPLEMENT THIS METHOD. THE EFFORT IS BEING CENTERED AROUND DEVELOPING A FORMALISM FOR DERIVING IMAGES FROM DIGITIZED HOLOGRAMS AND USING THIS FORMALISM TO EVALUATE DIFFERENT POSSIBLE SYSTEM DESIGNS AND DETERMINE THEIR PERFORMANCE CAPABILITIES.

NICHOLS RESEARCH CORP  
4040 S MEMORIAL PKWY  
HUNTSVILLE, AL 35802  
CONTRACT NUMBER:  
ROBERT L. HERSHBERGER  
TITLE:  
NEUTRON DETECTOR FOR NEUTRAL PARTICLE BEAM DISCRIMINATION  
TOPIC# 3                      OFFICE:

CENTRAL TO THE USE OF NEUTRAL PARTICLE BEAMS (NPB) AS A DISCRIMINATOR FOR STRATEGIC DEFENSE APPLICATIONS IS THE DETECTION OF NEUTRONS FROM THE NPB INDUCED NUCLEAR REACTIONS WITH AS LARGE AN EFFICIENCY AS POSSIBLE WHILE AT THE SAME TIME DISCRIMINATING AGAINST THE COSMIC RAY AND PRECURSOR NUCLEAR ATTACK PRODUCED NEUTRON AND GAMMA RAY BACKGROUNDS. SUCH A DETECTOR DOES NOT YET EXIST AND IN FACT IS LIMITED BY FUNDAMENTAL PHYSICAL PROPERTIES. A DESIGN IS BEING DEVELOPED AND DEMONSTRATED FOR INTEGRATING COLLIMATION, THRESHOLDING

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AND A LONG COUNTER TYPE NEUTRON DETECTOR FOR THE DETECTION OF NEUTRONS FROM NPB INDUCED NUCLEAR REACTIONS. THE FEASIBILITY OF THE ENHANCED LONG COUNTER DESIGN IS BEING ESTABLISHED THROUGH A COMPUTER SIMULATION. THE EXTENT AND EFFECTIVENESS OF THRESHOLD ENERGY DISCRIMINATION AND OF BACKGROUND REDUCTION BY COLLIMATION IS BEING BOUNDED. THE CRITICAL DESIGN CALCULATIONS ARE BEING BENCHMARKED THROUGH LABORATORY TESTS. COMMERCIALY AVAILABLE DEVICES AND MATERIALS ARE BEING IDENTIFIED WHICH CAN BE USED TO BUILD A PROTOTYPE NEUTRON SENSOR. IF THE DETECTOR IS SHOWN TO BE FEASIBLE, A DESIGN FOR A PROTOTYPE NEUTRON SENSOR WILL BE PRODUCED AS AN INPUT TO LATER PROTOTYPE DEVELOPMENT AND TESTING. THE MORSE MONTE CARLO CODE IS BEING USED TOGETHER WITH LABORATORY TESTS TO OBTAIN THE OPTIMUM COMBINATION OF COMPONENTS FOR THE PROTOTYPE DESIGN.

NICHOLS RESEARCH CORP  
4040 S MEMORIAL PKWY  
HUNTSVILLE, AL 35802  
CONTRACT NUMBER:  
JAYE BASS  
TITLE:  
DISCRIMINATION USING POLARIZED SIGNATURES  
TOPIC# 3                      OFFICE:

SOLVING THE PROBLEM OF MID-COURSE DISCRIMINATION IS CRITICAL TO A CREDIBLE BALLISTIC MISSILE DEFENSE SYSTEM. FAILURE TO PERFORM MID-COURSE DISCRIMINATION PROPERLY WILL RESULT IN AN OVERLOADED TERMINAL DEFENSIVE TIER CAUSING UNACCEPTABLE LEAKAGE RATES. POLARIZATION DISCRIMINATION EXPLOITS FUNDAMENTAL TARGET CHARACTERISTICS AND, THEREFORE, HAS THE POTENTIAL TO ENHANCE CONSIDERABLY THE EFFECTIVENESS OF PASSIVE INFRARED OPTICS TO DISCRIMINATE BETWEEN OBJECTS IN THE MID-COURSE REGIME. USING THE POLARIZED CONTENT OF A LONG-WAVELENGTH INFRARED TARGET SIGNATURE AS A DISCRIMINANT FOR APPLICATION TO THE EXOATMOSPHERIC DISCRIMINATION PROBLEM IS BEING INVESTIGATED. PREVIOUS THEORETICAL AND EMPIRICAL WORK SUGGEST THAT THIS METHOD HAS A NONTRIVIAL PROBABILITY OF SUCCESS. HOWEVER, THE EMPIRICAL WORK, CONSISTING OF DETAILED ANALYSIS OF POLARIZED TARGET SIGNATURES GENERATED BY THE OPTICAL SIGNATURE CODE, ASSUMED THE SYSTEM TO BE ERROR FREE. THUS, IN DETERMINING THE FEASIBILITY OF THIS NEW DISCRIMINATION TECHNIQUE, TWO SOURCES OF ERROR

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ARE BEING INVESTIGATED. THESE SOURCES ARE THE ERRORS INHERENT TO THE PARTICULAR MEASUREMENT TECHNIQUE EMPLOYED TO EXTRACT THE POLARIZED CONTENT OF A TARGET SIGNATURE AND SENSOR NOISE. BY INCLUDING REALISTIC ERROR SOURCES, THIS EFFORT IS EXTENDING THE STATE OF THE ART OF POLARIZATION DISCRIMINATION.

OPTELECOM INC  
15930 LUANNE DR  
GAITHERSBURG, MD 20877  
CONTRACT NUMBER:  
WILLIAM H CULVER  
TITLE:  
FREQUENCY SCANNING LASER FOR SENSOR AND OPTICAL RADAR  
TOPIC# 3                      OFFICE:

A SINGLE MODE CONTINUOUSLY TUNABLE LASER WHICH CAN ACCESS ANY WAVELENGTH WITHIN ITS BANDWIDTH IN MICROSECONDS COULD FORM THE BASIS OF SEVERAL TYPES OF SENSOR SYSTEMS AND OPTICAL RADAR SYSTEMS. SUCH SYSTEMS COULD DETECT AND IDENTIFY AIRBORNE PARTICLES OR CHEMICAL SPECIES OR IDENTIFY AND TRACK AIRCRAFT OR SPACECRAFT. THE LASER OUTPUT FREQUENCY WOULD REMAIN STATIONARY OR SCAN UP OR DOWN AS NEEDED. THE CHANGE IN FREQUENCY WOULD BE BROUGHT ABOUT BY A PHASE MODULATION (AS IN FM RADIO TECHNIQUES) AND THUS OCCUR IN A CONTINUOUS MANNER. A NOVEL LASER RESONATOR DESIGN IS BEING INVESTIGATED THAT ALLOWS CONTINUOUS SINGLE MODE TUNING OVER A RANGE OF SEVERAL NANOMETERS IN ONE MILLISECOND. TARGET SPECIFICATIONS OF FREQUENCY SCANNING LASER ARE BEING DETERMINED FROM ANTICIPATED APPLICATIONS, INCLUDING REQUIREMENTS OF WAVELENGTH, OUTPUT POWER, POWER CONSUMPTION SCAN RATE, AND STABILITY. PRELIMINARY LASER DESIGN IS BEING DEVELOPED THAT EMBODIES THE ABOVE TARGET SPECIFICATIONS. COMPUTER PROGRAM IS BEING WRITTEN TO MODEL THE PERFORMANCE OF THE SCANNING LASER AND ITS COMPONENTS. THIS MODEL IS BEING USED TO DETERMINE THE SPECIFICATIONS OF THE LASER INCLUDING THE GAIN MEDIUM, ACOUSTO-OPTIC CELL AND TUNABLE OPTICAL FILTER. A PROGRAM PLAN IS BEING DEVELOPED FOR CONTINUED WORK IN A LATER PHASE LEADING TO PROOF-OF-CONCEPT LASER.

OPTIVISION INC  
744 SAN ANTONIO RD - STE 10  
PALO ALTO, CA 94303  
CONTRACT NUMBER:  
ALEXANDER A SAWCHUK  
TITLE:  
OPTICAL BUS EXTENDERS FOR HIGH SPEED COMPUTERS  
TOPIC# 11                      OFFICE:

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A BUS EXTENDER IS A MEANS FOR HIGH-SPEED INTERCONNECTION OF A MULTITUDE OF INDIVIDUAL COMPUTING MODULES COMPRISING A DISTRIBUTED COMPUTING SYSTEM. WHEN THE ELEMENTS TO BE INTERCONNECTED ARE SPACED BY DISTANCES OF MORE THAN A VERY FEW METERS, THERE ARE SIGNIFICANT ADVANTAGES TO THE USE OF OPTICS FOR PROVIDING THE INTERCONNECTS. THE FEASIBILITY IS BEING EXAMINED OF USING OPTICAL BUS EXTENDERS IN A STRATEGIC DEFENSE SYSTEM. THE ADVANTAGES AND LIMITATIONS OF BOTH FREE-SPACE COMMUNICATION AND FIBER COMMUNICATION OVER SHORT DISTANCES ARE BEING DETERMINED. CRITICAL ISSUES ARE THE BULK AND COST OF COMPONENTS, AND THE EFFICIENCY WITH WHICH LIGHT CAN BE DETECTED AT THE END OF THE VARIOUS LINKS. OPTIMIZATION OF CERTAIN PARAMETERS OF THE EXTENDER ARE BEING EXPLORED WITH RESPECT TO BOTH COST AND PERFORMANCE. THE GENERAL RESULTS OBTAINED ARE BEING APPLIED TO THE SPECIAL CASE OF THE VME BUS. PROTOCOLS TO CONTROL ACTIVITY ON THE EXTENDER ARE BEING CONSIDERED AND A PREFERRED SOLUTION IS BEING PROPOSED. AS ISSUES ARISE THAT CAN BE RESOLVED ONLY BY BREADBOARDING A COLLECTION OF COMPONENTS OR A SMALL SUBSYSTEM, THEN SUCH BREADBOARDING IS BEING UNDERTAKEN. THE PROBLEM OF SIMULTANEOUSLY MAPPING THE STATE OF THE BUS TO SEVERAL REMOTE LOCATIONS IS BEING EXAMINED. VARIOUS METHODS FOR TAPPING THE OPTICAL ENERGY FOR MULTIPLE DESTINATIONS ARE BEING CONSIDERED AND THE OPTICAL EFFICIENCY AND COST OF THESE SOLUTIONS ARE BEING DETERMINED.

OPTRON SYSTEMS INC  
3 PRESTON CT  
BEDFORD, MA -1730  
CONTRACT NUMBER:  
ROBERT F DILLON  
TITLE:  
INTENSIFIED BISTABLE OPTICAL DEVICE  
TOPIC# 11                      OFFICE:

OPTICAL COMPUTERS ARE RECOGNIZED AS POTENTIALLY USEFUL ELEMENTS IN THE QUEST TO MEET THE INTENSE BATTLE MANAGEMENT COMPUTATIONAL REQUIREMENTS OF STRATEGIC DEFENSE. CURRENTLY, OPTICAL COMPUTERS ARE GREATLY LIMITED IN PERFORMANCE BECAUSE NO EXISTING NONLINEAR LIGHT MODULATION DEVICE SIMULTANEOUSLY OFFERS FAST OPTICAL SWITCHING WITH THRESHOLD HIGH GAMMA, HIGH SPATIAL BANDWIDTH, LOW POWER DISSIPATION, OPTICAL GAIN, AND HIGH RELIABILITY. A NONLINEAR SPATIAL LIGHT MODULATOR

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CALLED AN INTENSIFIED BISTABLE OPTICAL DEVICE IS BEING DEVELOPED WHICH OFFERS ALL THESE FEATURES AND, IN PRINCIPLE, CAN BE EFFICIENTLY MASS PRODUCED AT LOW COST. THIS DEVICE ACHIEVES OPTICAL GAIN AND CONSEQUENTLY CAN BE CASCADED TO REALIZE MANY COMPLEX OPTICAL COMPUTING ARCHITECTURES. THE FOLLOWING TASKS ARE BEING UNDERTAKEN: DEVICE PERFORMANCE ANALYSIS; PROTOTYPE DEVICE DESIGN; SMALL-SCALE PROTOTYPE DEVICE FABRICATION; DESIGN OPTIMIZATION; AND DEVICE PERFORMANCE TESTING. THE SUCCESSFUL DEVELOPMENT OF THE LOW-COST, NON-LINEAR HIGH PERFORMANCE SPATIAL LIGHT MODULATOR WOULD SIGNIFICANTLY ENHANCE THE CHANCES OF REALIZING USEFUL ALL-OPTICAL COMPUTERS WITHIN THE NEXT FIVE YEARS. OTHER APPLICATIONS INCLUDE ITS USE AS A FLAT PANEL DISPLAY SCREEN THAT EXHIBITS MEMORY AND AS A REUSABLE ELECTRONIC REPLACEMENT FOR PHOTOGRAPHIC FILM IN CERTAIN INDUSTRIAL APPLICATIONS.

PARTNERSHIPS LTD INC  
PO BOX 6503  
LAWRENCEVILLE, NJ 08648  
CONTRACT NUMBER:  
DR PAUL H KYDD  
TITLE:  
HYPERVELOCITY PROJECTILES FOR ION BEAM COALESCENCE  
TOPIC# 1                      OFFICE:

INDIVIDUAL IONS MAY BE ACCELERATED EASILY TO VELOCITIES OF HUNDREDS OF KILOMETERS PER SECOND BY VIRTUE OF THEIR HIGH CHARGE-TO-MASS RATIO. IF IT WERE POSSIBLE TO ACCELERATE A BEAM OF IONS TO SUCH VELOCITIES AND THEN TO NEUTRALIZE AND COALESCE SUCH HYPERVELOCITY IONS INTO MASSIVE PROJECTILES, IT WOULD CONSTITUTE A BREAKTHROUGH IN THE CREATION OF HYPERVELOCITY PROJECTILES. A BEAM OF MASSIVE PARTICLES HAS SIGNIFICANT ADVANTAGES OVER AN ION OR NETURAL BEAM. THE PRIMARY ONE IS THAT THE FORMATION OF A PARTICLE FROM THE BEAM OF IONS IN EFFECT REDUCES THE BEAM TEMPERATURE TO VERY LOW LEVELS AND MAINTAINS ITS FOCUS OVER GREAT DISTANCES AND LONG TIMES. THE FEASIBILITY IS BEING ASSESSED OF GENERATING HYPERVELOCITY PROJECTILES FROM COALESCED ION BEAMS. ESTIMATES ARE BEING PROVIDED OF THE CHARACTERISTICS OF A PROTOTYPE WEAPONS SYSTEM BASED ON THIS CONCEPT AND OF A PROPOSED EXPERIMENTAL PROGRAM TO BE CARRIED OUT IN LATER PHASES. AN EXPERIMENTAL PROGRAM IS BEING DESIGNED TO PROVIDE DATA TO CONFIRM OR DISPROVE THE FEASIBILITY ASSESSMENT. SUCCESS IN THIS ACTIVITY WOULD

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OPEN UP A NEW FIELD OF SCIENTIFIC INVESTIGATION ON PARTICLE INTERACTIONS AT HIGH ENERGY AND IN HYPERVELOCITY IMPACT. APPLICATIONS TO FUSION POWER GENERATION AND SEMICONDUCTOR FABRICATION ARE POSSIBLE.

PELLISSIPPI INTERNATIONAL  
10521 RESEARCH DR - STE 300  
KNOXVILLE, TN 37932  
CONTRACT NUMBER:  
DR WILLIAM A GIBSON  
TITLE:  
SUBMICRON ELECTRONIC DEVICE USING FIELD-EMISSION TIP  
TOPIC# 14                      OFFICE:

A SUBMICRON ELECTRONIC DEVICE IS BEING DEVELOPED. IN LIEU OF USING SEMICONDUCTOR MATERIALS, THIS ALTERNATIVE DEVICE CONSISTS OF A FIELD-EMISSION TIP WITH DIMENSIONS OF 50 X 300 NM, CLOSELY SPACED TO A THIN METAL FOIL. A NEGATIVE VOLTAGE APPLIED TO THE CONDUCTIVE TIP CAUSES A CURRENT TO FLOW FROM THE FOIL TO THE TIP DUE TO ELECTRON FIELD EMISSION FROM THE POINTED TIP. THE DEVICE IS THUS SIMILAR TO A VACUUM TUBE, BUT WITH DIMENSIONS SMALLER THAN COMPONENTS OF MODERN INTEGRATED CIRCUITS AND RELYING UPON FIELD EMISSION RATHER THAN THERMIONIC EMISSION. SIMILAR DEVICES ON A LARGER SCALE HAVE BEEN STUDIED FOR MANY YEARS, BUT ONLY RECENTLY HAVE PRACTICAL METHODS FOR THE REQUISITE MICROLITHOGRAPHY BECOME AVAILABLE. A SUCCESSFUL DEVICE WOULD HAVE OPERATING PARAMETERS SIMILAR TO PRESENT SEMICONDUCTOR DEVICES, BUT WITH HIGHER TOLERANCE TO RADIATION AND TEMPERATURE CHANGES. IN THIS EFFORT, A LARGE NUMBER OF TIPS ARE BEING FORMED ON A SUBSTRATE AND THEIR COLLECTIVE CHARACTERISTICS ARE BEING INVESTIGATED. ADVANTAGES AND DISADVANTAGES COMPARED TO CURRENT SEMICONDUCTOR DEVICES ARE BEING STUDIED. THE USE OF THESE STRUCTURES FOR AN ELECTRON GUN IS BEING DEMONSTRATED. INITIAL APPLICATIONS WOULD LIKELY LIE IN COMPUTERS AND RUGGED CIRCUITS FOR DEFENSE AND SPACE SYSTEMS.

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BOTHELL, WA 98011  
CONTRACT NUMBER:  
DR ENDER SAVRUN  
TITLE:  
EFFICIENT THERMIONIC CONVERTER FOR SPACE POWER SYSTEMS  
TOPIC# 4                      OFFICE:

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SINCE THE OUTPUT POTENTIAL OF A THERMIONIC CONVERTER FOR SPACE POWER UNDER CURRENT DESIGN IS BASICALLY RESTRICTED TO THE DIFFERENCE BETWEEN EMITTER AND THE COLLECTOR WORK FUNCTIONS, A NEW APPROACH IS REQUIRED TO INCREASE ITS EFFICIENCY. ONE SUCH APPROACH WOULD UTILIZE A THERMIONIC EMITTER EMPLOYING THE FIELD EMISSION EFFECT, POSSIBLY COMBINED WITH LOWERING OF THE ELECTRODE WORK FUNCTIONS. THIS WOULD REQUIRE THE DEVELOPMENT OF A NEW COMPOSITE ELECTRODE MATERIAL THAT POTENTIALLY COULD PROVIDE A WAY TO ACHIEVE A LOW BARRIER INDEX THERMIONIC CONVERTER CAPABLE OF OPERATING AT HIGH TEMPERATURES. SUCH AN IMPROVED THERMIONIC CONVERTER SYSTEM IS BEING DEVELOPED FOR SPACE POWER APPLICATIONS. THE GROWTH PROCESSES ARE BEING INVESTIGATED LEADING TO COUPLED GROWTH AND ALIGNED MICROSTRUCTURES DURING THE DIRECTIONAL SOLIDIFICATION OF THIN LAYERS OF TUNGSTEN-REFRACTORY-OXIDE EUTECTIC MIXTURES ON A TUNGSTEN SUBSTRATE. THESE PLATES ARE BEING EVALUATED AS POTENTIAL ELECTRODE MATERIALS FOR THERMIONIC ENERGY CONVERTERS. HIGH EFFICIENCY THERMIONIC ENERGY CONVERTERS UTILIZING INNOVATIVE MATERIALS WOULD HAVE DIRECT USE NOT ONLY IN SPACE POWER STATIONS, BUT ALSO IN OTHER REMOTE POWER APPLICATIONS.

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DR TOMASZ JANNSON  
TITLE:  
HIGHLY-PARALLEL HOLOGRAPHIC INTEGRATED PLANAR INTERCON  
TOPIC# 11                      OFFICE:

TO FILL THE NEED OF SECURED AND HIGH-BANDWIDTH STRATEGIC COMPUTING, A NOVEL OPTOELECTRONIC INTERCONNECT SYSTEM IS BEING DEVELOPED THAT NOT ONLY HAS THE NEEDED HIGH DENSITY PARALLEL INTERCONNECTABILITY FOR INTER-CHIP AND INTER-PROCESSOR COMMUNICATION, BUT ALSO PRESERVES THE DURABILITY AND COMPACTNESS COMPATIBLE WITH MONOLITHIC ELECTRONIC DEVICES. THIS CONFIGURATION IS BASED ON TWO HOLOGRAPHIC CONCEPTS FUNCTIONING TOGETHER WITH OPTOELECTRONICS IN INTERCONNECTING SIGNAL AMONG VLSI PROCESSORS OR SUBSYSTEMS. THE RESULTING INTERCONNECT CONFIGURATION COMBINES THE TWO HOLOGRAPHIC TECHNOLOGIES IN AN INTEGRATED OPTICS MONOLITHIC FORMAT THAT PERFORMS ULTRA-HIGH DENSITY INTERCONNECT OPERATIONS IN A CO-PLANAR MANNER. USING THIS APPROACH,



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TWO-DIMENSIONAL COHERENT OPTICAL INTERCONNECT AND PROCESSING IS BEING IMPLEMENTED IN A COMPACT FORMAT WITHOUT THE PACKAGING PROBLEMS ASSOCIATED WITH BULK OPTICAL ELEMENTS. INTERCONNECTION ARCHITECTURE IN BOTH THE STATIC OR THE RECONFIGURABLE MODE CAN BE APPLICABLE TO HIGHLY PARALLEL SELF-ORGANIZED NEURO-OPTIC PROCESSORS, INTRA-COMPUTER CONNECTIONS AS WELL AS HIGH-HIERARCHY COMPUTER NETWORKS.

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TITLE:  
LASER COUNTERMEASURE HOLOGRAPHIC RUGATE FILTERS FOR  
ULTRAVIOLET RADIATION  
TOPIC# 8                      OFFICE:

THE EMERGING TECHNOLOGIES OF SHORT WAVELENGTH LASERS SUCH AS ULTRAVIOLET (UV) EXCIMER AND X-RAY LASERS HAVE CREATED AN URGENT NEED FOR NEW TECHNIQUES THAT ARE EFFECTIVE IN STRATEGIC SYSTEM HARDENING AGAINST ATTACK RADIATIONS IN UV AND XUV REGIONS. ALTHOUGH FOR THE VISIBLE AND NEAR-INFRARED REGION THERE EXIST NUMEROUS APPROACHES FOR LASER COUNTERMEASURE INCLUDING HOLOGRAPHIC FILTERS, THEIR APPLICATION IN THE UV REGION IS HAMPERED BY SEVERE LIMITATION DUE TO HIGHER MATERIAL ABSORPTION, LOWER LASER DAMAGE THRESHOLD AND ENVIRONMENTAL INSTABILITY. RECENT HOLOGRAPHIC MATERIAL AND RECORDING TECHNOLOGY BREAKTHROUGHS ARE BEING APPLIED FOR FABRICATING HIGH OPTICAL DENSITY UV HOLOGRAPHIC FILTERS FOR LASER COUNTERMEASURE APPLICATIONS. TWO DIFFERENT METHODS OF OBTAINING HIGH EFFICIENCY UV HOLOGRAMS ARE BEING INVESTIGATED. ULTRAVIOLET HOLOGRAPHIC FILTERS FABRICATED ON RECENTLY DEVELOPED MATERIALS ARE BEING PRODUCED WHICH COULD HAVE THE DESIRED BANDWIDTH AND OPTICAL DENSITY TO ENHANCE THE SURVIVAL OF SYSTEMS AND SENSORS AGAINST UV LASER THREATS. AS THE TECHNOLOGY IS SCALABLE TO DIFFERENT SIZES, IT COULD FIND APPLICATIONS RANGING FROM ENHANCING THE SURVIVABILITY OF THE SENSORS TO ACTING AS HIGH EFFICIENCY HOLOGRAPHIC OPTICAL ELEMENTS FOR COMMERCIAL OPTICS.

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LASER MASS DRIVER  
TOPIC# 1                      OFFICE:

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DIRECTED ENERGY WEAPONS (DEW) AND KINETIC ENERGY WEAPONS (KEW) EACH HAVE A PRINCIPAL ADVANTAGE AND WEAKNESS. DEW IS THE HIGH PROBABILITY OF INTERCEPTING A TARGET WITH PRECISION POINTING AND ZERO TIME-OF-FLIGHT. ITS PRINCIPAL WEAKNESS IS THE UNCERTAIN OR UNKNOWN LETHALITY OF SUCH DEVICES, AND THE ASSOCIATED CRITICALITY OF KILL ASSESSMENT. CONVERSELY, KEW HAS THE HIGH PROBABILITY OF A LETHAL ENCOUNTER WITH A TARGET. ITS MAJOR WEAKNESS IS THE FINITE TIME-OF-FLIGHT OF PROJECTILES AND THE UNCERTAINTIES ASSOCIATED WITH TRAJECTORY PREDICTION AND CONTROL. A NEW WEAPONS CONCEPT THAT TAKES ADVANTAGE OF BOTH DEW AND KEW, WHILE ELIMINATING THEIR WEAKNESSES, IS BEING INVESTIGATED. THIS HYBRID CONCEPT, A LASER MASS DRIVER, CONSISTS OF FIVE BASIC COMPONENTS: A REPETITIVELY PULSED LASER, AN ARRAY OF PROPAGATION MIRRORS, A TRACKING SENSOR (PASSIVE OR ACTIVE), A COMPUTER (AND POINTING/TRACKING ALGORITHM), AND AN ARRAY OF PROJECTILES (HYPERVELOCITY BALLOONS). DEMONSTRATION OF A PLAUSIBLE SYSTEM CONSTRUCT, PRELIMINARY SPECIFICATION OF SYSTEM COMPONENTS, AND DESIGN OF CRITICAL SIMULATION EXPERIMENTS ARE BEING UNDERTAKEN. THE WORK PLAN INCLUDES ANALYTICAL MODELING, COMPUTER SIMULATION AND AN OPTIONAL SUBSCALE DEMONSTRATION EXPERIMENT.

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DR MELVIN I PRICE  
TITLE:  
X-RAY LASER THREAT TO SYSTEM SURVIVABILITY  
TOPIC# 8                      OFFICE:

SPACE-BASED ASSETS NEED TO SURVIVE A VARIETY OF POTENTIAL THREATS. GREAT EMPHASIS HAS BEEN PLACED ON NUCLEAR THREATS AND SYSTEMS ARE CURRENTLY BEING BUILT WITH GOOD PROTECTION AGAINST MANY OF THEIR DELETERIOUS EFFECTS. ONE OUTSTANDING THREAT THAT NEEDS ADDITIONAL PROTECTION IS THE DIRECTED ENERGY WEAPON AND, IN PARTICULAR, AN X-RAY LASER. LASERS PRODUCE VERY HIGH CONCENTRATIONS OF ENERGY WHICH CAN BE PROPAGATED THROUGH SPACE AND USED TO DEFEAT ONBOARD SENSORS AND, IN EXTREME CASES, AN ENTIRE SPACE PLATFORM. X-RAY LASERS HAVE THE POTENTIAL OF PENETRATING PROTECTIVE LAYERS WHICH ARE USED AND INTERACTING WITH THE INTERNAL SENSITIVE SUBSYSTEMS. A NEW CONCEPT FOR

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PROTECTING SPACE VEHICLES IS BEING INVESTIGATED USING X-RAY OPTICAL COMPONENTS TO COLLECT THE INCOMING RADIATION AND SHUNT IT AROUND THE ENTIRE VEHICLE WITHOUT ALLOWING ANY ABSORPTION OR PENETRATION INTO THE SENSITIVE AREAS. RECENT DEVELOPMENTS IN THE SPACE SCIENCES HAVE PRODUCED GRAZING-INCIDENCE, X-RAY TELESCOPES WHICH ARE VERY EFFECTIVE IN COLLECTING AND FOCUSING SMALL AMOUNTS OF ENERGY ONTO DETECTORS. THESE DEVELOPMENTS ARE BEING APPLIED TO THE REVERSE PROBLEM OF COLLECTING AND DISPERSING THE LARGE AMOUNT OF ENERGY EXPECTED FROM AN X-RAY LASER.

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DR GARY BULLARD  
TITLE:  
HIGH POWER PULSE ENERGY SYSTEM CONCEPT  
TOPIC# 5                      OFFICE:

A SINGLE DEVICE DOES NOT YET EXIST THAT IS CAPABLE OF STORING SUFFICIENT ENERGY FOR LONG PERIODS AND, AT THE SAME TIME, IS CAPABLE BOTH OF RELEASING IT IN 100 MW PULSES FOR BURST POWER AND OF PROVIDING LIMITED PERIODS OF 100 KW POWER FOR SUSTAINED POWER APPLICATIONS. A HIGH POWER PULSE ENERGY SYSTEM IS BEING INVESTIGATED THAT POTENTIALLY COULD ADDRESS THIS NEED. SUCH A SYSTEM WOULD COMPRISE TWO STATE-OF-THE-ART DEVICES: A VERY HIGH ENERGY DENSITY BATTERY AND AN EXCEPTIONALLY HIGH POWER DENSITY ULTRACAPACITOR. DEPENDING ON THE DUTY CYCLE OF THE PULSE POWER APPLICATION, THE HIGH POWER PULSE ENERGY SYSTEM COULD BE VERY COMPACT AND POWERFUL. THE HIGH ENERGY AND POWER DENSITIES OF SUCH A HIGH POWER PULSE ENERGY SYSTEM COULD PROVIDE A UNIQUE POWER SOURCE FOR MANY MINIATURE ELECTRONIC APPLICATIONS, PARTICULARLY FOR BACK-UP POWER SUPPLY FOR COMPUTER MEMORY DURING POWER BROWN-OUT.

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C PAUL CHRISTENSEN  
TITLE:  
ULTRAVIOLET WAVEGUIDE LASERS FOR PHASED ARRAY LIDAR  
TOPIC# 3                      OFFICE:

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A PROOF OF PRINCIPLE EXPERIMENT IS BEING CONSTRUCTED THAT WILL CLEARLY DEMONSTRATE THE ESSENTIAL ELEMENTS OF ARRAY OPERATION. AN OSCILLATOR AND TWO AMPLIFIER SECTIONS ARE BEING SUBJECTED TO PERFORMANCE TESTS. PHASE ARRAY OPTICAL RADARS OR LIDARS OPERATING WITH RELATIVELY LARGE SYNTHETIC APERTURES CAN EXHIBIT MANY OF THE SAME RAPID POINTING AND TRACKING FEATURES ASSOCIATED WITH MICROWAVE SYSTEMS, AND, IN ADDITION, ARE CAPABLE OF IMAGING DISTANT TARGETS BY SCANNING WITH HIGH RESOLUTION BEAMS. AN ULTRAVIOLET PHASED-ARRAY LIDAR SYSTEM BASED ON NEW BUT PROVEN ULTRAVIOLET WAVEGUIDE TECHNOLOGY WOULD BE CAPABLE OF OPERATION AT HIGH REPETITION RATES WITHOUT GAS FLOW, ELECTRONICALLY VARIABLE PULSE DURATION, IMPROVED OPERATING AND STORAGE LIFETIME, AND ENHANCED OVERALL EFFICIENCY. THE FEASIBILITY IS BEING DEMONSTRATED THAT THESE FEATURES CAN BE ACHIEVED BY A PHASED ARRAY LIDAR WHICH UTILIZES NEW MICROWAVE DISCHARGE XECl WAVEGUIDE LASER TECHNOLOGY.

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TITLE:  
SPACE OPERATIONS DECISION SUPPORT MODEL  
TOPIC# 6                      OFFICE:

A DETAILED SPACE OPERATIONS LOGISTICS MODEL EXISTS THAT COULD ESTABLISH THE UP/DOWN TRAFFIC AND COST STATISTICS ASSOCIATED WITH CONTINUING ON-ORBIT SPACE OPERATIONS. THIS MODEL OF SPACE OPERATIONS APPEARS TO HAVE CAPABILITIES IN ITS OWN RIGHT THAT CAN BE UTILIZED EFFECTIVELY BY MISSION AND TRANSPORTATION SYSTEM PLANNERS TO INCORPORATE SPACE LOGISTICS CONSIDERATIONS INTO THEIR PLANS AND ANALYSES. THESE CAPABILITIES CAN PROVIDE A BROAD RANGE OF INFORMATION INCLUDING UP/DOWN TRAFFIC AND COST STATISTICS ASSOCIATED WITH INDIVIDUAL MISSIONS, GROUPS OF MISSIONS, MAINTENANCE SCENARIOS AND TRANSPORTATION SYSTEMS. A MICROPROCESSOR-BASED SPACE OPERATIONS DECISION SUPPORT MODEL IS BEING REFINED AND IMPLEMENTED THAT IS EASY TO ACCESS AND USE BY BOTH MISSION AND TRANSPORTATION SYSTEM PLANNERS. THE BASIC SET OF EQUATIONS THAT DEFINES THE SPACE OPERATIONS DECISION SUPPORT MODEL ALREADY HAS BEEN DEVELOPED AND THE MODIFICATIONS REQUIRED FOR APPLICATION TO A MICROPROCESSOR ARE BEING UNDERTAKEN.

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THE DEVELOPED CAPABILITY WILL LEAD TO IMPROVED DECISIONS WITH RESPECT TO MISSION AND TECHNOLOGY INVESTMENTS BY PROVIDING THE MEANS FOR ACCOUNTING FOR SPACE OPERATIONS LOGISTICS THAT EXPLICITLY CONSIDER THE CONSEQUENCES OF LESS THAN PERFECT RELIABILITY OF LAUNCH AND PAYLOAD SUBSYSTEMS.

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2 RESEARCH CT  
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DR GOERGE STORTI  
TITLE:  
WIDE SPECTRAL BAND FAST RESPONSE HIGH DETECTIVITY DETE  
MATERIALS  
TOPIC# 14                      OFFICE:

THE RESPONSE OF PRESENTLY AVAILABLE HIGH DETECTIVITY DETECTORS COULD BE EXTENDED FURTHER INTO INFRARED WAVELENGTHS BY COUPLING THEM WITH NEW MATERIALS THAT HAVE BEEN DEVELOPED. EFFORTS ARE REQUIRED TO OPTIMIZE OPTICAL UPCONVERSION EFFICIENCIES, WAVELENGTH SENSITIVITY, AND LOW NOISE CHARACTERISTICS OF THESE MATERIALS. MATERIALS RESEARCH IS BEING PERFORMED SO THAT THE FEASIBILITY OF A FAST RESPONSE, WIDE SPECTRAL BANDWIDTH, HIGH DETECTIVITY DETECTOR CAN BE DETERMINED. MATERIAL PROPERTIES ARE BEING DETERMINED THAT SUBSTANTIALLY INFLUENCE ELECTRON TRAPPING AND SUBSEQUENT UPCONVERSION TO VISIBLE PHOTONS IN THE ELECTRON TRAPPING MATERIALS. ELECTRON TRAPPING AND UPCONVERSION EFFICIENCIES ARE BEING MEASURED. THE REPEATABILITY OF THE PHOTONIC PROCESSES IS BEING EVALUATED SO THAT CALIBRATION CAPABILITIES CAN BE DETERMINED. THE REPEATABILITY OF THE MATERIALS PREPARATION ALSO IS BEING ASSESSED.

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DR JOSEPH LINDMAYER  
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SOLID STATE HIGH RESOLUTION PHOTOGRAPHY  
TOPIC# 3                      OFFICE:

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THE NEW ELECTRON TRAPPING (ET) MATERIALS DISPLAY LARGE AND STABLE ELECTRON TRAPPING. IN CERTAIN COMPOUNDS, THE WHOLE VISIBLE LIGHT ENERGY SPECTRUM IS CAPABLE OF EXCITING ELECTRONS INTO TRAPS. ACCORDINGLY, A PHOTOGRAPHIC IMAGE CAN BE GENERATED IN THE FORM OF TRAPPED ELECTRON DISTRIBUTION. IT SEEMS THAT VERY HIGH RESOLUTIONS ARE POSSIBLE AND THE SENSITIVITY SHOULD BE HIGH. THE LIMITS OF PRACTICAL SENSITIVITY IS BEING STUDIED BY EXAMINING THE ET MATERIALS FOR LOW-LIGHT LEVEL BEHAVIOR. MEASUREMENT FACILITIES ARE BEING SET UP FOR VERY LOW PHOTON INPUT AND SCANNING APPARATUS IN ORDER TO READ VERY LOW EMITTED LIGHT LEVELS. EXISTING ET MATERIALS ARE BEING EXAMINED FOR THEIR FEW-PHOTON CHARACTERISTICS AS IS REQUIRED FOR SENSITIVE SOLID STATE PHOTOGRAPHY. TEMPERATURE DEPENDENCE OF SENSITIVITY AND NOISE FIGURE ARE BEING EVALUATED FOR EXISTING ET MATERIALS DOWN TO LIQUID NITROGEN TEMPERATURES. SENSITIVITY OF GRAINY LAYERS AS WELL AS SURFACE CRYSTALS ARE BEING EVALUATED AND COMPARED TO STANDARD FILM VALUES. PROCESSING PARAMETERS WHICH HAVE THE GREATEST EFFECT ON THE SENSITIVITY ARE BEING EXAMINED. POTENTIAL IS BEING ASSESSED OF SOLID STATE REUSABLE PHOTOGRAPHY BASED ON THE DATA COLLECTED.

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TITLE:  
FOCUSSING HARD X-RAY TELESCOPE  
TOPIC# 3                      OFFICE:

MEASUREMENT OF THE RATIOS OF CHARACTERISTIC X-RAY LINES EMITTED BY EXCITED TARGETS OFFER A MEANS OF DISTINGUISHING BETWEEN DECOYS AND RE-ENTRY VEHICLES IN THE EXOATMOSPHERE. THE SENSITIVITY OF THE X-RAY MEASUREMENTS WOULD BE GREATLY IMPROVED IN THE PRESENCE OF BACKGROUND BY USING A TELESCOPE TO CONCENTRATE THE INCIDENT X-RAY FLUX. CONVENTIONAL GRAZING INCIDENCE X-RAY OPTICS ARE IMPRACTICAL AT THE ENERGIES OF THE CHARACTERISTIC K LINES OF ELEMENTS WITH LARGE ATOMIC NUMBER. THE FEASIBILITY OF A NEW CLASS OF HARD X-RAY TELESCOPE IS BEING DEMONSTRATED USING SYNTHETIC MULTILAYERED STRUCTURES AS X-RAY REFLECTING ELEMENTS. A PROPER MULTILAYER SPACING IS BEING SELECTED AS A FUNCTION OF POSITION THAT ALLOWS THE TELESCOPE TO BE TUNED TO A

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SPECIFIC X-RAY WAVELENGTH, E.G., A CHARACTERISTIC SPECTRAL LINE. A PROTOTYPE TELESCOPE TUNED TO A CHARACTERISTIC LINE OF INTEREST FOR STRATEGIC DEFENSE APPLICATIONS IS BEING DESIGNED. A FOCUSSED HARD X-RAY TELESCOPE WOULD BE USEFUL IN X-RAY ASTRONOMY FOR THE STUDY OF SOLAR FLARES, SUPERNOVA REMNANTS, AND OTHER CELESTIAL OBJECTS. SUCH A TELESCOPE ALSO COULD BE USED AS A COLLIMATOR IN MEDICAL AND INDUSTRIAL X-RAY IMAGING. HARD X-RAY OPTICS MIGHT ALSO PROVE USEFUL IN X-RAY SPECTROSCOPY AND SYNCHROTRON RADIATION STUDIES.

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PETER P F RADKOWSKI III  
TITLE:  
ADVANCED PENETRATOR CONFIGURATION PERFORMANCE  
TOPIC# 2                      OFFICE:

KINETIC ENERGY WEAPONS PLAY A CRITICAL ROLE IN DETERMINING BALLISTIC MISSILE DEFENSE (BMD) SYSTEM REQUIREMENTS. SENSOR ASSESSMENT OF THREAT DESTRUCT CAN BENEFIT FROM THE CAPABILITY OF KINETIC ENERGY DEVICES TO INDUCE CATASTROPHIC RESPONSES IN BALLISTIC MISSILE TARGETS. SIMILARLY, THRUST AND MANEUVERING CAPABILITIES OF BMD INTERCEPTORS CAN BENEFIT FROM THE LESSENING OF MASS- AND VELOCITY-RELATED LETHALITY REQUIREMENTS OF KINETIC ENERGY DEVICES. THE INVESTIGATION UNDERWAY IS ASSESSING THE MASS-PERFORMANCE OF A PROPRIETARY CLASS OF ADVANCED PENETRATOR CONFIGURATIONS IN TERMS OF ENHANCED CAPABILITIES TO INDUCE SUCH CATASTROPHIC TARGET RESPONSES AS: BLOWOUT; GROSS STRUCTURAL FAILURE; AND/OR DETONATION OF VOLATILE TARGET MATERIALS. THE IMPACT, PENETRATION AND POST-PERFORATION PROCESSES ARE BEING ASSESSED THROUGH PREDICTION AND TEST VERIFICATION. REPRESENTATIVE STANDARD AND ADVANCED PENETRATOR CONFIGURATIONS ARE BEING TEST-FIRED AT HIGH VELOCITIES. TARGET RESPONSES ALSO ARE BEING EVALUATED.

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JESSE C DOBSON  
TITLE:  
HIGH TEMPERATURE INSULATOR ELECTRICAL CONDUCTIVITIES A  
LOW OXYGEN ACTIVITIES  
TOPIC# 4                      OFFICE:

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HIGH TEMPERATURE ELECTRICAL INSULATORS ARE A KEY COMPONENT FOR RELIABLE, LONG DURATION ELECTRICAL POWER GENERATION BY THERMIONIC AND THERMOELECTRIC SPACE NUCLEAR POWER SYSTEMS. THESE SYSTEMS REQUIRE LARGE QUANTITIES OF HIGH QUALITY INSULATORS IN ORDER TO ACHIEVE RATED PERFORMANCE FOR PERIODS OF 5-10 YEARS OR MORE. FEASIBILITY IS BEING INVESTIGATED OF USING THE NON-DESTRUCTIVE TECHNIQUE OF AC IMPEDANCE SPECTROSCOPY (ACIS) FOR DETERMINING THE ELECTRIC TRANSPORT CHARACTERISTICS OF THESE INSULATOR MATERIALS AND FOR EVENTUAL MASS PRODUCTION QUALITY CONTROL. AN INSULATOR SAMPLE, WHOSE PROPERTIES ARE WELL CHARACTERIZED, IS BEING TESTED WITH ACIS IN AN EXPERIMENTAL APPARATUS WHICH ALLOWS THE TEMPERATURE AND THE OXYGEN ACTIVITY AROUND THE SAMPLE TO BE VARIED. TO THE EXTENT POSSIBLE, THE ACIS TECHNIQUE IS BEING USED TO MEASURE THE INDIVIDUAL TRANSPORT COMPONENTS ASSOCIATED WITH THE PHYSICAL PROCESSES. IF SUCCESSFUL, THIS WORK IS EXPECTED TO RESULT IN THE DEVELOPMENT OF A NON-DESTRUCTIVE TECHNIQUE FOR INSULATOR EVALUATION. LATER STUDY WOULD INVOLVE THE GENERATION OF A DATA BASE FOR THE INSULATOR MATERIALS OF INTEREST TO THE SPACE NUCLEAR POWER PROGRAMS, THE CORRELATION OF THE RESULTS WITH PHYSICO-CHEMICAL CHARACTERISTICS, THE DEVELOPMENT AND VERIFICATION OF COMPUTER MODELS SUITABLE FOR SYSTEM PERFORMANCE CALCULATIONS, AND THE DEVELOPMENT OF A MASS PRODUCTION QUALITY CONTROL APPROACH.

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HUGO HUEY  
TITLE:  
PLASMA OPENING AND CLOSING SWITCH  
TOPIC# 5                      OFFICE:

ADVANCED MILITARY AND INDUSTRIAL SYSTEMS FOR SPACE APPLICATIONS ARE NOW BEING DEFINED WHICH REQUIRE HIGH PULSE-POWER SWITCHING CAPABILITIES. NEW, BEYOND THE STATE-OF-THE-ART CHARACTERISTICS INCLUDE A COMBINATION OF SEVERAL KEY ELEMENTS SUCH AS HIGH VOLTAGE STANDOFF, LOW FORWARD VOLTAGE DROP (LOW "ON" IMPEDANCE, HIGH "OFF" IMPEDANCE), HIGH CURRENT CLOSING AND OPENING CHARACTERISTICS, HIGH PULSE REPETITION RATE, FAST SWITCHING TIMES, LOW STANDBY POWER, INSTANT READINESS AND RUGGED OPERATION. THE IDEAL SWITCH TO SATISFY



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ALL OF THE ABOVE REQUIREMENTS MUST COMBINE FEATURES OF THE VACUUM-THERMIONIC SWITCH TUBES AND GAS DISCHARGE PLASMA SWITCHES. A MODULATOR SWITCH IS BEING INVESTIGATED THAT EMPLOYS A HIGHLY EFFICIENT RF DISCHARGE PLASMA TO PROVIDE HIGH CONDUCTION CURRENTS WITH LOW FORWARD VOLTAGE DROP. THE SWITCH ALSO HAS CURRENT INTERRUPTION CAPABILITIES AS IN VACUUM-THERMIONIC DEVICES. THE PRODUCTION OF A COMPACT RF DISCHARGE PLASMA IS BEING DEMONSTRATED AND CHARACTERIZED. UPON COMPLETION, THERE WILL BE A DEMONSTRATION OF THE SWITCH OPENING AND CLOSING CAPABILITY. THE HIGH IONIZATION FRACTION OF THE PLASMA GIVES THIS DEVICE EXCELLENT POTENTIAL FOR MEETING THE NEEDS OF A HIGH VOLTAGE, HIGH CURRENT, OPENING AND CLOSING SWITCH. THE RESULTS OF THIS WORK, IF SUCCESSFUL, WILL SERVE AS A BASIS FOR THE DEVELOPMENT OF NEW STATE-OF-THE-ART HIGH POWER PLASMA MODULATOR SWITCHES.

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OXYGEN CONTROL FOR THERMIONIC CONVERTERS  
TOPIC# 4                      OFFICE:

THE ADDITION OF SMALL QUANTITIES OF OXYGEN INTO A THERMIONIC CONVERTER HAS LONG BEEN RECOGNIZED AS A POSSIBLE MEANS OF ALLOWING A WIDER INTERELECTRODE SPACING WITHOUT PERFORMANCE PENALTY OR ALTERNATIVELY OF IMPROVING THE OUTPUT PERFORMANCE CHARACTERISTICS RELATIVE TO A CONVERTER WITHOUT THE OXYGEN ADDITIVE. TO DATE, ONLY EMPIRICAL APPROACHES TO ACHIEVING OXYGEN ADDITION HAVE BEEN REALISED, WITH QUALITY CONTROL CRUDE AND UNREPRODUCIBLE EXCEPT WITHIN VERY BROAD LIMITS. A MEANS IS BEING EXAMINED FOR INTRODUCING, DETERMINING, AND CONTROLLING THE OXYGEN CONTENT OF A CONVERTER IN A VERY PRECISE WAY THROUGH THE APPLICATION OF AN ELECTROCHEMICAL CELL. THE USE OF SUCH CELLS FOR OXYGEN TRANSFER, MEASUREMENT, AND CONTROL IS WELL UNDERSTOOD AND ESTABLISHED, BUT IT HAS NOT BEEN APPLIED TO THESE PURPOSES IN THE THERMIONIC CONVERTER. A FEASIBILITY EXPERIMENT AND EVALUATION OF APPLYING THIS TECHNOLOGY IS BEING CONDUCTED, WHICH, IF SUCCESSFUL, WOULD LEAD TO THE DEVELOPMENT OF AN INTEGRATED CONVERTER IN A LATER EFFORT. THE PRIMARY APPLICATION OF THE THERMIONIC CONVERSION PROCESS

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IS PRESENTLY IN IN-CORE THERMIONIC SPACE POWER REACTORS, ALTHOUGH A COMPARABLE PROCESS HAS RECEIVED CONSIDERATION IN THE PAST AS A TOPPING CYCLE FOR COMMERCIAL POWER PLANTS.

RUPPRECHT & PATASHNICK CO INC  
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CONTRACT NUMBER:

DR GEORGE RUPPRECHT

TITLE:

MASS LOSS ANALYSIS OF MATERIALS SUBJECTED TO LASER IRR  
USING A TAPERED ELEMENT OSCILLATING MICROBALANCE INSTR  
TOPIC# 9 OFFICE:

THE INVESTIGATION OF THE INTERACTION OF MATERIALS UNDER LASER IRRADIATION IS OF CRITICAL IMPORTANCE TO STRATEGIC DEFENSE SYSTEMS. INSTRUMENTATION NEEDS TO BE DEVELOPED TO MEASURE THE MASS LOSS FROM A TARGET MATERIAL UNDERGOING INTERACTION WITH A LASER BEAM. IDEALLY, MASS MEASUREMENTS SHOULD BE ACCOMPLISHED IN REAL TIME, AND THE TIME RESOLUTION OF THE INSTRUMENT SHOULD BE SHORT ENOUGH TO ALLOW FOR MEASUREMENTS OF MASS LOSS BETWEEN LASER PULSES. THE FEASIBILITY IS BEING EXAMINED OF DEVELOPING AN INSTRUMENT CAPABLE OF REAL TIME MASS MONITORING OF LASER TARGET MATERIALS. BASED ON TECHNOLOGY WHICH ENABLES DIRECT MASS MEASUREMENTS IN REAL TIME UNDER CONDITIONS NOT SUITED FOR GRAVIMETRIC MASS DETERMINATIONS, THIS INVESTIGATION COULD ADVANCE THE STATE OF THE ART OF RAPID MASS MEASUREMENTS, ULTIMATELY PERMITTING THE MONITORING OF MASS LOSS FROM TARGET MATERIALS BETWEEN LASER PULSES. DESIGN OF THE SYSTEM AND DEFINITION OF THE LIMITS OF THE TECHNOLOGY ARE BEING ADDRESSED. FABRICATION AND TESTING OF THE INSTRUMENTATION WOULD OCCUR AT A LATER PHASE. IF SUCCESSFUL, THIS INVESTIGATION WOULD RESULT IN A FAST, ACCURATE MASS MEASURING INSTRUMENTATION FOR LASER-MATERIAL INTERACTION STUDIES.

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CONTRACT NUMBER:

JAMES R DOWNER

TITLE:

SUPERCONDUCTING MAGNETIC BEARINGS FOR HIGH PERFORMANCE  
MOMENTUM-EXCHANGE EFFECTOR  
TOPIC# 1 OFFICE:

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PRECISION POINTING OF LARGE PAYLOADS REQUIRES TORQUES AND ANGULAR MOMENTUM STORAGE CAPACITIES THAT ARE LARGE IN COMPARISON TO THE CAPABILITIES OF AVAILABLE HARDWARE. IN ADDITION, THE POINTING ACTUATOR MUST HAVE EXTREMELY LOW TORQUE JITTER. HIGH TORQUE AND LOW NOISE COMBINE TO PRODUCE AN EXTREMELY DIFFICULT DESIGN CONSTRAINT FOR MECHANICAL BEARINGS SINCE ROLLING ELEMENTS TRANSMIT VIBRATIONS DIRECTLY TO THE SUPPORTING STRUCTURE. THE USE OF MAGNETIC BEARINGS IN ANGULAR MOMENTUM EXCHANGE EFFECTORS HAS THE PRIMARY ADVANTAGE THAT PHYSICAL CONTACT BETWEEN THE ROTOR AND STATOR IS ELIMINATED. FOR CONVENTIONAL MAGNETIC BEARINGS, HIGH TORQUES MAY REQUIRE THAT THE MAGNETIC STRUCTURE BE EXCESSIVELY MASSIVE. AN ALTERNATIVE DESIGN EMPLOYS A SUPERCONDUCTING COIL AND ELIMINATES ALL CONVENTIONAL MAGNETIC STRUCTURES. THE BASELINE APPROACH IS TO REPLACE THE PERMANENT MAGNET AND MAGNETIC STRUCTURE OF A CONVENTIONAL MAGNETIC BEARING WITH THE SUPERCONDUCTING COIL. IN THE SUPERCONDUCTING MAGNETIC BEARING, A SINGLE COIL REPLACES TWO PERMANENT MAGNET STRUCTURES IN ORDER TO PRODUCE AN ENERGY-EFFICIENT, LIGHT-WEIGHT DESIGN. A DESIGN DEFINITION AND DETAILED ANALYSIS OF A SUPERCONDUCTING BEARING SYSTEM IS BEING DEVELOPED. FROM THESE RESULTS A LABORATORY PROTOTYPE COULD BE CONSTRUCTED AND TESTED IN A LATER PHASE.

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CONTRACT NUMBER:  
RICHARD HOCKNEY  
TITLE:

SUPERCONDUCTING LINEAR ACTUATOR FOR HIGH PERFORMANCE S  
APPLICATIONS  
TOPIC# 1                      OFFICE:

IN MANY STRATEGIC APPLICATIONS, IT IS NECESSARY TO CONNECT THE FORE AND AFT BODIES IN A MANNER WHICH ALLOWS HIGH TORQUE TO BE APPLIED TO THE FORE BODY WHILE SIMULTANEOUSLY ISOLATING THE FORE BODY FROM AFT BODY VIBRATIONS. THIS CREATES A PARADOX SINCE A VERY STIFF INTERCONNECTION IS REQUIRED TO TRANSMIT HIGH TORQUES WHILE A VERY SOFT INTERCONNECTION IS NEEDED TO PROVIDE ISOLATION. PAST APPROACHES TO THIS PROBLEM HAVE BEEN MECHANICALLY COMPLEX AND HAVE TENDED TO HAVE

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SUBSTANTIALLY REDUCED ISOLATION CAPABILITY WHILE TRANSMITTING TORQUE. LARGE-FORCE SUPERCONDUCTING LINEAR-ACTUATORS REPRESENT A PROMISING APPROACH TO ISOLATING AND CONTROLLING THE FORE BODY. THESE ACTUATORS, WHICH WORK ON A VOICE-COIL PRINCIPLE, COMBINE HIGH FORCE, LIGHT WEIGHT, AND HIGH BANDWIDTH. BECAUSE OF THEIR OPERATING PRINCIPLES AND CHARACTERISTICS, THESE ACTUATORS ARE CAPABLE OF SIMULTANEOUSLY PROVIDING LARGE FORCE TRANSMISSION AND HIGH LEVELS OF VIBRATION ISOLATION. THESE ACTUATORS ARE AN ENABLING TECHNOLOGY WHERE IMPROVEMENTS WILL TRANSLATE DIRECTLY INTO IMPROVED SYSTEM PERFORMANCE AND CAPABILITIES. THE FEASIBILITY OF THESE HIGH PERFORMANCE ACTUATORS FOR THE FORE-AFT BODY ISOLATION TASK IS BEING INVESTIGATED BY DEVELOPING AND ANALYZING A SUPERCONDUCTING LINEAR ACTUATOR SIZED FOR THIS APPLICATION.

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CONTRACT NUMBER:

DR JAMES R DOWNER

TITLE:

MAGNETIC BEARINGS APPLICATIONS TO ROTATING MACHINERY F  
POWER GENERATION

TOPIC# 5

OFFICE:

MAGNETIC BEARINGS REPRESENT A PROMISING APPROACH TO CONTROLLING THE LARGE ANGULAR MOMENTUMS AND IMBALANCES ASSOCIATED WITH SPACE BASED POWER GENERATING MACHINERY. WITHOUT THIS CONTROL, THESE LARGE ANGULAR MOMENTUMS AND IMBALANCES WOULD LEAD TO UNACCEPTABLE TORSIONAL AND TRANSLATIONAL INTERACTIONS WITH THE SPACECRAFT. ROTATING MACHINE SYSTEMS INCLUDING TURBINES, GENERATORS, FLYWHEELS, AND THEIR CONTROLS ARE THE PREFERRED CANDIDATE FOR MANY STRATEGIC DEFENSE POWER GENERATION APPLICATIONS. THESE SYSTEMS WILL HAVE ANGULAR MOMENTUMS MANY ORDERS OF MAGNITUDE LARGER THAN THOSE OF PRIOR SPACE SYSTEMS. CURRENT STATE OF THE ART IN THE KEY COMPONENT TECHNOLOGY AREAS SUCH AS FLYWHEELS, GENERATORS, AND TURBINES ARE BEING REVIEWED. SEVERAL REPRESENTATIVE "STRAWMAN" APPROACHES ARE BEING SELECTED FOR DETAILED EVALUATION. BASELINE MAGNETIC SUSPENSION APPROACHES ARE BEING DEVELOPED FOR THESE CONFIGURATIONS TOGETHER WITH CONTROL SYSTEM CONCEPTS THAT WILL AUTONOMOUSLY MANAGE THE ANGULAR MOMENTUM OF THE

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FLYWHEEL AND ATTENUATE VIBRATION INPUTS TO THE SPACECRAFT. THE RESEARCH, IF SUCCESSFUL, WILL ALLOW THE POTENTIAL BENEFITS OF MAGNETIC BEARING TECHNOLOGY (HIGH EFFICIENCY, REDUCED VIBRATION, AND EXTREMELY LONG LIFE) TO BE REALIZED FOR SPACECRAFT APPLICATIONS.

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CONTRACT NUMBER:  
B FRIEDLANDER  
TITLE:  
PARALLEL IMPLEMENTATION OF SEQUENCE ANALYSIS  
TOPIC# 10                      OFFICE:

DYNAMIC PROGRAMMING IS A RECURSIVE COMPUTATIONALLY EFFICIENT OPTIMIZATION TECHNIQUE FOR SOLVING A CLASS OF MULTI-STAGE DECISION PROBLEMS. IT PROVIDES THE OPTIMUM SOLUTION AT A MUCH SMALLER COMPUTATIONAL COST THAN EXHAUSTIVE SEARCH. THE DYNAMIC PROGRAMMING ALGORITHM (DPA) HAS POTENTIAL APPLICATIONS TO A NUMBER OF IMPORTANT STRATEGIC DEFENSE PROBLEMS INCLUDING: MULTI-TARGET TRACKING, DATA FUSION, AND TARGET CLASSIFICATION. IN SPITE OF ITS POTENTIAL, THE DPA RARELY HAS BEEN APPLIED TO REAL-TIME SIGNAL PROCESSING PROBLEMS DUE TO ITS COMPUTATIONAL REQUIREMENTS. PROCESSING TECHNOLOGY NEEDS TO BE DEVELOPED TO REALIZE PRACTICAL APPLICATIONS OF THE DPA. THE DPA LENDS ITSELF TO IMPLEMENTATION USING PARALLEL PROCESSING ARCHITECTURES WITH LOCAL INTERCONNECTIONS, SUCH AS SYSTOLIC ARRAYS. EXTREMELY HIGH PROCESSING RATES CAN BE ACHIEVED IN PRINCIPLE BY TAPPING THE POWER OF PARALLEL COMPUTING. VERY LITTLE WORK HAS BEEN DONE TO DATE TO EXPLORE THE OPTIMUM PARALLEL IMPLEMENTATION OF THE DPA. RESEARCH IS BEING UNDERTAKEN TO DEVELOP A PARALLEL ULTRA-HIGH-SPEED DPA PROCESSOR FOCUSSED ON THE DETECTION AND TRACKING OF A LARGE NUMBER OF TARGETS FROM A SEQUENCE OF INFRARED IMAGES.

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CONTRACT NUMBER:  
B FRIEDLANDER  
TITLE:  
SYSTOLIC PROCESSOR FOR REAL-TIME TARGET CLASSIFICATION  
TOPIC# 3                      OFFICE:

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THE SPEED OF IMAGE IDENTIFICATION AND SCENE ANALYSIS IN ADVANCED SURVEILLANCE SYSTEMS DESIGNED TO DETECT, TRACK, AND CLASSIFY MULTIPLE TARGETS IS GREATLY LIMITED BY THE I/O BANDWIDTH OF THE PROCESSOR EMPLOYED. HOWEVER, A FAST PROCESSOR IS OFTEN UTILIZED INEFFICIENTLY DUE TO AN ALGORITHM WHICH NEEDS FREQUENT MEMORY ACCESS. ALGORITHMS NEED TO BE DEVELOPED WITH A MINIMAL NUMBER OF REFERENCES TO THE INPUT IMAGES THAT CAN BE USED FOR VARIOUS PURPOSES SUCH AS IMAGE FILTERING, SEGMENTATION, AND FEATURE EXTRACTION, AND THAT CAN BE IMPLEMENTED BY A UNIQUE SYSTOLIC ARCHITECTURE. A NEW CLASS OF IMAGE PROCESSING ALGORITHMS FOR TARGET CLASSIFICATION AND RELATED APPLICATIONS ARE BEING DEVELOPED. THESE RASTER-SCAN ALGORITHMS ARE EXPECTED TO MINIMIZE MEMORY ACCESS TIME WHICH IS A PRINCIPAL BOTTLENECK IN IMAGE PROCESSING. CONNECTIVITY-MAPPING AND CHAIN-CODE MAPPING ALGORITHMS ARE BEING IMPLEMENTED ON A SYSTOLIC ARRAY TO ACHIEVE THE SPEED-UP NEEDED FOR REAL-TIME PROCESSING. THESE ALGORITHMS ARE ANTICIPATED TO PROVIDE THE PRIMITIVE OPERATIONS NEEDED FOR IMAGE FILTERING, SEGMENTATION, EDGE DETECTION, SKELETON EXTRACTION, AND FEATURE EXTRACTION. EXTENSIONS OF THE BASIC ALGORITHMS TO MULTIPLE GREY LEVEL IMAGES, MULTIPLE LOOK-ANGLES, AND RECURSIVE UPDATING ARE ALSO BEING CONSIDERED.

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CONTRACT NUMBER:  
B FRIEDLANDER  
TITLE:  
ALGORITHM-BASED FAULT TOLERANCE FOR SYSTOLIC ARRAYS  
TOPIC# 10                      OFFICE:

ALGORITHM-BASED FAULT TOLERANCE (ABFT) IS A NEW TECHNIQUE FOR DETECTING AND CORRECTING ERRORS IN A REGULAR ARRAY OF MICROPROCESSORS. THIS TECHNIQUE ENHANCES AND COMPLEMENTS CONVENTIONAL FAULT TOLERANCE TECHNIQUES AND APPEARS TO OFFER CONSIDERABLE IMPROVEMENT IN RELIABILITY AT A MODEST COST. THIS APPROACH IS AIMED SPECIFICALLY AT PROCESSORS DESIGNED TO PERFORM NUMERICAL COMPUTATIONS FOR SIGNAL PROCESSING APPLICATIONS. THE DEVELOPMENT OF THE ABFT TECHNIQUE IS BEING CONTINUED AND ITS APPLICABILITY EXTENDED TO A WIDER CLASS OF PROBLEMS. THE COST (IN TERMS OF HARDWARE OR COMPUTER TIME) OF

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IMPLEMENTING THE ABFT IS BEING EVALUATED FOR VARIOUS PROCESSING ARCHITECTURES AND COMPUTATIONAL PROBLEMS. THE ABFT TECHNIQUE IS A VALUABLE TECHNIQUE FOR IMPROVING THE RELIABILITY OF MULTIPROCESSOR SYSTEMS, ESPECIALLY WHEN IMPLEMENTED IN VLSI/WSI TECHNOLOGY. APPLICATIONS ARE EXPECTED FOR BOTH COMMERCIAL AND MILITARY PARALLEL PROCESSING SYSTEMS AND FOR SYSTOLIC ARRAYS IN PARTICULAR.

SCHAFER W J ASSOCS INC  
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CONTRACT NUMBER:  
RAYMOND F WALSH IV  
TITLE:  
SHORT WAVE CHEMICAL LASER TECHNOLOGY AND APPLICATIONS  
ANALYSES  
TOPIC# 1                      OFFICE:

FOR BOOST PHASE DEFENSE AGAINST FAST-BURN AND DEPRESSED-TRAJECTORY THREATS, SHORT WAVELENGTH CHEMICAL LASERS (SWCL) ARE ATTRACTIVE CANDIDATES SINCE THEY WOULD CONVERT CHEMICAL ENERGY DIRECTLY INTO COHERENT RADIATION AND WOULD AVOID THE LARGE OPTICAL SYSTEMS ASSOCIATED WITH INFRARED CHEMICAL LASERS. SWCLS ARE BEING MODELED AND TRADE-OFF ANALYSES PERFORMED TO DETERMINE WHERE THEY HAVE COST AND PERFORMANCE ADVANTAGES FOR STRATEGIC DEFENSE. SYSTEM OPTIMIZATION CODES ARE BEING USED TO PARAMETRICALLY EVALUATE THE MAJOR COMPONENT TECHNOLOGIES OF SWCLS TO DETERMINE THE TECHNOLOGY DRIVERS AND ESTABLISH THE COST TRADEOFF BETWEEN WAVELENGTH AND LASER EFFICIENCY. THESE COST TRADEOFFS ARE BEING DONE RELATIVE TO HYDROGEN FLUORIDE CHEMICAL LASERS, ASSUMING THAT THE LASER DEVICE AND THE FUEL STORAGE SYSTEMS SCALE LIKE HF. IN ADDITION TO THE OPTICAL SYSTEMS SCALING WITH WAVELENGTH, AN ATTEMPT IS BEING MADE TO MODEL THE ADDED MANUFACTURING DIFFICULTIES OF ACHIEVING LOW SURFACE SCATTER AND ADAPTIVE OPTICS AT WAVELENGTHS BELOW ONE MICROMETER. AN ASSESSMENT IS BEING UNDERTAKEN TO DETERMINE WHETHER GAIN OR FUEL EFFICIENCY IS MORE APPROPRIATE FOR DETERMINING THE SIZE OF THE LASER DEVICE. THE DATA GENERATED IS BEING USED TO ESTABLISH THE OPTIMUM ARCHITECTURAL DEPLOYMENT FOR REPRESENTATIVE SWCLS, AND TO QUANTIFY THE RELATIVE IMPACT OF COMPONENT TECHNOLOGY ON SYSTEM COST.

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CHELMSFORD, MA 01824  
CONTRACT NUMBER:  
J CHARLES ALBERS  
TITLE:  
DIRECT TARGET TRACKING BY KINETIC ENERGY WEAPONS  
TOPIC# 2                      OFFICE:

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THE SPACE-BASED KINETIC ENERGY WEAPON PROGRAM PIVOTS ON THE TRANSITION OF TRACK FROM PLUME TO MISSILE HARDBODY AIMPOINT IN THE BOOST PHASE INTERCEPT PROBLEM. YET THIS APPROACH IS AN ARTIFACT OF PRESENTLY CONCEIVED PASSIVE KILL VEHICLE SEEKER DESIGNS AND SIGNAL PROCESSING TECHNIQUES, NOT AN ASPECT OF THE PROBLEM ITSELF. THERE IS A NEED FOR A PASSIVE TECHNIQUE THAT COMPLETELY CIRCUMVENTS THE NECESSITY TO MAKE THE TRANSITION BY HOMING ON A SIGNAL WHICH IS UNIQUE TO THE BODY. THE TECHNIQUE IS BASED ON THE POLARIZATION DEPENDENCY OF BOTH EMISSIVITY AND REFLECTIVITY AT OFF-NORMAL VIEWING ANGLES. THIS DEPENDENCY APPEARS SUFFICIENTLY STRONG TO PROVIDE A MEANS FOR LOCATING A MISSILE BODY SUBMERGED IN BACKGROUND NOISE. THE OBVIOUS BENEFIT IS THAT THE HARDBODY CAN BE TRACKED AT MUCH GREATER RANGES THAN FOR CONVENTIONAL TECHNIQUES AND THE INSENSITIVITY TO VEHICLE MANEUVERS FROM A TARGETING STANDPOINT IS SELF-EVIDENT. THE FEASIBILITY IS BEING ESTABLISHED FOR USING THE POLARIZATION CONTENT OF THE HARDBODY SIGNATURE TO DIRECTLY LOCATE IT IN THE PRESENCE OF THE PLUME. THE HARDWARE FEASIBILITY OF THE APPROACH IS BEING ESTABLISHED. THE ISSUES AND UNCERTAINTIES IN THE APPROACH ARE BEING IDENTIFIED. MEASUREMENTS AND/OR FEASIBILITY DEMONSTRATIONS ARE BEING RECOMMENDED.

SCHAFFER W J ASSOCS INC

321 BILLERICA RD

CHELMSFORD, MA 01824

CONTRACT NUMBER:

M JOHN YODER

TITLE:

ENHANCED PULSER-SUSTAINER ELECTRIC DISCHARGE TECHNOLOG

TOPIC# 3

OFFICE:

THE CAPABILITY OF ENHANCED IONIZER/SUSTAINER ELECTRIC DISCHARGE TECHNOLOGY IS BEING ASSESSED FOR LONG PULSE HIGH FLUX CO2 LASER APPLICATIONS SUCH AS OPTICAL IMAGING/DISCRIMINATION, DOPPLER LASER RADAR MEASUREMENTS AND SENSOR NEGATION. THE ORIGINAL IONIZER/SUSTAINER CONCEPT USED A SHORT ELECTRICAL PULSE DIRECTLY ACROSS THE MAIN DISCHARGE REGION TO VOLUME IONIZE THE LASER GAS. A DIRECT CURRENT LOW VOLTAGE POWER SUPPLY USED THE RECOMBINING ELECTRONS FROM THE IONIZING PULSE TO ELECTRICALLY PUMP THE VIBRATIONAL MODES OF THE CO2 AND N2 GAS BETWEEN THE ELECTRODES. THE ENHANCED PULSER/ALTERNATING CURRENT SUSTAINER CONCEPT PROPOSED FOR STUDY HERE



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USES: A DOUBLE-PULSE PULSER; A HIGH-FREQUENCY ALTERNATING CURRENT SUSTAINER DISCHARGE USING DIELECTRIC ELECTRODES; AND HIGH INTENSITY SMALL-SCALE GAS FLOW TURBULENCE. A DESIGN IS BEING DEVELOPED AND THE PRELIMINARY PROOF-OF-CONCEPT TEST IS BEING UNDERTAKEN. THE CONCEPT, IF SUCCESSFUL, WOULD PROVIDE FOR A VERY ROBUST HARDWARE IMPLEMENTATION, AND PROVIDE THE ATTRACTIVE CAPABILITIES OF E-BEAM/SUSTAINER LASERS WITHOUT THE PENALTIES PAID DUE TO THE FRAGILE E-BEAM HARDWARE IMPLEMENTATION. COMMERCIAL APPLICATION FOR SUCH ROBUST, HIGH POWER DENSITY LASER EMITTERS ARE IN CUTTING, MARKING, SURFACE ALLOYING AND SURFACE HARDNESS MODIFICATION.

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JEFFREY B SHELLAN  
TITLE:  
OPTICAL COATING DESIGNS FOR ANNULAR RESONATORS  
TOPIC# 1 OFFICE:

THE DESIGN AND FABRICATION OF HIGH REFLECTIVITY MULTILAYER DIELECTRIC COATINGS FOR VERY HIGH POWER ANNULAR OPTICS, SUCH AS FOR THE ALPHA RESONATOR, PRESENTS SPECIAL CHALLENGES. THE COATINGS MUST HAVE A HIGH DAMAGE THRESHOLD, HAVE HIGH REFLECTIVITY AND LOW SCATTER, BE ENVIRONMENTALLY STABLE AND DURABLE, AND PROVIDE THE NECESSARY POLARIZATION PHASE CONTROL. THE DESIGN OF NOVEL ANNULAR COATINGS THAT IS BEING UNDERTAKEN IS INTENDED FOR USE ON LASERS WITH OUTPUT POWERS OF AT LEAST FOUR TIMES ALPHA II. BECAUSE OF THE HIGH LASER OUTPUT POWERS ASSUMED, ADVANCED COATING MATERIALS AND DEPOSITION PROCESSES ARE BEING CONSIDERED IN THE DESIGN. FOR EXAMPLE, IF DIELECTRIC ABSORPTION LEVELS CAN BE REDUCED BY FACTORS OF 5 TO 10 USING ADVANCED COATING TECHNIQUES SUCH AS REACTIVE SPUTTERING, THEN THE ADVANTAGES OF DESIGNS CONTAINING 25-35 LAYERS CAN BE REALIZED. THE HIGH REFLECTIVITIES OF THESE DESIGNS WOULD THEN RELAX THE COOLING REQUIREMENTS, REDUCE BEAM JITTER CAUSED BY COOLANT FLOW, AND LESSEN THE ADAPTIVE OPTICS REQUIREMENTS.

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TITLE:  
EXPANDING FLOW PLASMA SOURCE FOR HIGH BRIGHTNESS NEGAT  
DEUTERON BEAMS  
TOPIC# 1 OFFICE:

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THE TRANSPORT OF AN INTENSE BEAM OF PARTICLES FROM A SOURCE TO A DISTANT TARGET REQUIRES A HIGH QUALITY BEAM WITH A BRIGHTNESS GREATER THAN CURRENTLY AVAILABLE. A HIGH DENSITY NEGATIVE ION BEAM SOURCE FOR PRODUCING HIGH BRIGHTNESS NEUTRAL PARTICLE BEAMS IS BEING INVESTIGATED THAT UTILIZES A HIGH DENSITY PLASMA DISCHARGE FOR PRODUCING HIGH BRIGHTNESS NEGATIVE DEUTERON BEAMS. A SIGNIFICANT IMPROVEMENT IN BEAM BRIGHTNESS COULD BE ACHIEVED IF THE IONS WERE TO BE PRODUCED AT A MUCH HIGHER PLASMA DENSITY THAN CURRENTLY BEING INVESTIGATED. A NEGATIVE ION SOURCE IS BEING EXAMINED WHICH SEEKS TO ACHIEVE A HIGH BRIGHTNESS DEUTERIUM ION BEAM BY EXPLOITING THE ADVANTAGES INHERENT IN HIGH DENSITY ION PRODUCTION. A HIGH DENSITY, LOW TEMPERATURE PLASMA IS GENERATED IN A PLASMA SOURCE AND EXPANDS AWAY FROM THE EXIT APERTURE TOWARD THE EXTRACTION PLANE. BRIGHTNESS IS COMPARABLE AS THE PLASMA EXPANDS, HENCE THE PERPENDICULAR ION TEMPERATURE RISES AS THE PLASMA EXPANDS TOWARD THE EXTRACTION PLANE. EXTRACTION PLANE IS LOCATED WHERE THE PLASMA DENSITY HAS DROPPED TO A SUFFICIENTLY LOW VALUE FOR OPTIMUM EXTRACTION CONDITIONS. THE SOURCE CONFIGURATION OFFERS THE UNIQUE CAPABILITY OF PRODUCING THE SOURCE PERFORMANCE FOR HIGH BRIGHTNESS WHILE SATISFYING THE NECESSARY CONDITION AT THE EXTRACTION PLANE. THE SOURCE HAS THE POTENTIAL TO INCREASE NEGATIVE ION BEAM BRIGHTNESS BY A FACTOR GREATER THAN 10.

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NEW HAVEN, CT 06510  
CONTRACT NUMBER:  
DENNIS J PHILBIN  
TITLE:  
MAPPING COMPUTATIONAL PROBLEMS ONTO PARALLEL ARCHITECTURE  
TOPIC# 10      OFFICE:

THE EFFICIENT PARALLEL IMPLEMENTATION OF METHODS IN SCIENTIFIC COMPUTATION REQUIRES CAREFUL DECISIONS ON THE PARALLEL ARCHITECTURES TO BE BUILT AND THE ALGORITHMS TO BE IMPLEMENTED ON THE CHOSEN ARCHITECTURE. A METHODOLOGY EXISTS THAT WILL PERMIT BUILDING OF A SOFTWARE SYSTEM TO STREAMLINE THIS DECISION MAKING PROCESS. SUCH SOFTWARE IS BEING DEVELOPED THAT WOULD BE CAPABLE OF EFFICIENTLY EVALUATING THE POSSIBLE PAIRINGS OF PARALLEL ALGORITHMS AND

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ARCHITECTURES THEREBY SPEEDING THE DESIGN PROCESS. THE METHODOLOGY BEING EMPLOYED IS AN EXTENSION OF ONE FOR THE DESIGN OF SYSTOLIC ARRAYS TO BE IMPLEMENTED IN VERY LARGE SCALE INTEGRATED CIRCUIT TECHNOLOGY. IT TAKES, AS INPUT, COUPLED SYSTEMS OF RECURRENCE EQUATIONS AND DELIVERS, AS OUTPUT, THE DESCRIPTION OF THE MOST EFFICIENT PARALLEL IMPLEMENTATION TO THE EVALUATION OF THESE EQUATIONS. THE PROBLEM OF MAPPING ALGORITHMS TO ARCHITECTURES IS BEING MADE COMPUTATIONALLY TRACTABLE BY TAKING ADVANTAGE OF THE INHERENT REGULARITY IN THE COMPUTATIONAL PROBLEMS AND THE PROCESSOR INTERCONNECTION STRUCTURE OF THE COMMERCIALY AVAILABLE ARCHITECTURES. THIS SOFTWARE PACKAGE WOULD ASSIST IN THE DEVELOPMENT OF SOFTWARE FOR MULTIPROCESSOR ARCHITECTURES AND WOULD PROVIDE PERFORMANCE ESTIMATES OF ALGORITHM IMPLEMENTATIONS ON A VARIETY OF PARALLEL ARCHITECTURES.

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TITLE:  
SEMICONDUCTING DIAMOND ELECTRONIC DEVICES  
TOPIC# 14                      OFFICE:

RECENT TECHNOLOGY ADVANCES HAVE DEMONSTRATED THE POSSIBILITY OF FABRICATING SATISFACTORY ELECTRONIC DIAMOND FILMS IN REASONABLE QUANTITIES. AS A CONSEQUENCE OF THIS, OLDER DESIGNS ARE BEING REWORKED AND NEW DEVICE STRUCTURES DEVELOPED THAT TAKE ADVANTAGE OF THE SEMICONDUCTING DIAMOND. HOWEVER, IT HAS BEEN THE EXPERIENCE OF THE SEMICONDUCTING COMMUNITY THAT DESIGN FEATURES SUITABLE FOR ONE SEMICONDUCTOR SYSTEM DO NOT DIRECTLY CARRY-OVER TO ANOTHER. NEW APPROACHES ARE REQUIRED TO TAILOR SPECIFIC DEVICE STRUCTURES TO THE PROPERTIES OF DIAMOND AND THE PRESENT STATE OF DIAMOND TECHNOLOGY. NUMERICAL SIMULATIONS OF DIAMOND DEVICES ARE BEING PERFORMED THROUGH IMPLEMENTATION OF A DRIFT AND DIFFUSION EQUATION ALGORITHM. TWO STRUCTURES ARE BEING CONSIDERED, THE DIAMOND PERMEABLE BASE TRANSISTOR AND A DIAMOND FIELD EFFECT TRANSISTOR. THE PERMEABLE BASE TRANSISTOR IS P-TYPE, AND THE DIAMOND FIELD EFFECT TRANSISTOR IS BEING EXAMINED FOR THE EFFECTS OF CONTACTS PROPERTIES ON THE CURRENT VOLTAGE CHARACTERISTICS. ADDITIONALLY, TRANSIENT NONEQUILIBRIUM

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CHARACTERISTICS OF DIAMOND ARE BEING OBTAINED.

SCIENTIFIC SYSTEMS INC  
ONE ALEWIFE PLACE  
CAMBRIDGE, MA 02140  
CONTRACT NUMBER:  
DONALD E GUSTAFSON

TITLE:  
DISTRIBUTED ALGORITHMS FOR PROBABILISTIC SOLUTIONS OF  
VISION PROBLEMS  
TOPIC# 3                      OFFICE:

IMAGE PROCESSING SYSTEMS SHOULD BE ABLE TO SOLVE IMPORTANT IMAGE UNDERSTANDING PROBLEMS SUCH AS DETERMINING STRUCTURE FROM MOTION AND EFFECTIVE USE OF APRIORI INFORMATION ON OBJECTS TO BE DETECTED OR RECOGNIZED. CURRENT ALGORITHMS TEND TO BE AD HOC, CONSISTING OF A CASCADE OF PROCESSORS WHICH MAY WORK AT CROSS PURPOSES. FOR EXAMPLE, A 2D FILTER IS OFTEN USED TO REDUCE NOISE WITH HIGH SPATIAL FREQUENCY CONTENT. THIS TENDS TO BLUR EDGES WHICH MUST BE DETECTED LATER. A MORE SUITABLE APPROACH WOULD BE TO COMBINE EDGE DETECTION AND NOISE REDUCTION IN A SINGLE STEP. A PROBABALISTIC FRAMEWORK IS BEING INVESTIGATED IN WHICH THE IMAGE IS MODELED AS A RANDOM FIELD TO BE ESTIMATED IN REAL TIME FROM NOISY AMBIGUOUS MEASUREMENTS FROM MULTIPLE SENSORS. A BAYESIAN VIEWPOINT IS BEING USED IN WHICH THE PRIOR KNOWLEDGE IS EXPRESSED AS A PROBABILITY DISTRIBUTION. USING A PROBABILISTIC DESCRIPTION OF THE OBSERVATION NOISE, THE POSTERIOR DISTRIBUTION OF THE RANDOM FIELD IS BEING COMPUTED. SIGNIFICANTLY, THESE ASSUMPTIONS ARE EXPECTED TO LEAD TO COOPERATIVE DISTRIBUTED ALGORITHMS WHICH MAY BE IMPLEMENTED ON PARALLEL PROCESSORS. BOTH PIECEWISE CONTINUOUS SURFACES AND THE BOUNDARIES BETWEEN SMOOTH PATCHES (TARGETS, CLOUDS, OBJECTS) ARE BEING MODELED. THE PARAMETERS THAT APPEAR IN THE RECONSTRUCTION ALGORITHMS ARE ANTICIPATED TO HAVE A PRECISE STATISTICAL INTERPRETATION WHICH MAY BE VALIDATED ON PHYSICAL GROUNDS.

SPACE COMPUTER CORP  
2800 OLYMPIC BLVD - STE 104  
SANTA MONICA, CA 90404  
CONTRACT NUMBER:  
WILLIAM B KENDALL  
TITLE:  
PASSIVE RANGING WITH ELECTRO-OPTICAL SENSORS  
TOPIC# 3                      OFFICE:

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THE PURPOSE OF THIS PROJECT IS TO DEVELOP AND DEMONSTRATED AN INNOVATIVE NEW APPROACH TO ONE OF THE MOST FUNDAMENTAL AND IMPORTANT PROBLEMS IN STRATEGIC DEFENSE VIA., PASSIVE RANGING WITH MULTIPLE ELECTRO-OPTICAL SENSORS. THE PHASE I EFFORT IS FOR THE DEMONSTRATION AND EVALUATION OF THE BASIC ALGORITHMS VIA COMPUTER SIMULATION, PLUS PRELIMINARY DESIGN OF A PROCESSOR ARCHITECTURE. THE PHASE EFFORT WILL INCLUDE DESIGN AND FABRICATION OF A BRASSBOARD PROCESSOR USING LOW-COST COMMERCIAL COMPONENTS, AND DEMONSTRATION OF PERFORMANCE WITH SIMULATED AND/OR ACTUAL SENSOR INPUTS. THE NEW APPROACH CAN BE APPLIED TO A LARGE NUMBER OF STRATEGIC DEFENSE SENSING SYSTEMS, INCLUDING BSTS, SSTS, KEW, LWIR PROBE, AOA, ETC. AS WELL AS TO BATTLE MANAGEMENT/C CUBED SYSTEMS. IT SHOULD ALSO BE APPLICABLE TO VARIOUS MILITARY RECONNAISSANCE, SURVEILLANCE AND INTELLIGENCE SYSTEMS INCLUDING THOSE FOR CRUISE MISSILE DETECTION.

SPACE COMPUTER CORP  
2800 OLYMPIC BLVD - STE 104  
SANTA MONICA, CA 90404

CONTRACT NUMBER:

WILLIAM B KENDALL

TITLE:

OBJECT DISCRIMINATION VIA BULK TEMPERATURE/VELOCITY FI  
TOPIC# 3 OFFICE:

AMONG THE WAYS PASSIVE ELECTRO-OPTICAL SENSORS MIGHT DISCRIMINATE BETWEEN REENTRY VEHICLES AND THE OBJECTS WHICH ACCOMPANY THEM ARE THE MEASUREMENT OF OBJECT TEMPERATURE USING THE RELATIVE BRIGHTNESS OF EACH OBJECT IN DIFFERENT SPECTRAL BANDS, AND THE MEASUREMENT OF BRIGHTNESS AND TEMPERATURE CHANGES OF EACH OBJECT AS A FUNCTION OF TIME. AN IMPORTANT PROBLEM TO BE SOLVED IS HOW TO IMPLEMENT THESE MEASUREMENTS IN A COMPUTATIONALLY EFFICIENT WAY SO THAT THEY CAN BE MADE ON VERY LARGE NUMBERS OF OBJECTS WITH PRACTICAL AMOUNTS OF HARDWARE. TO THIS END, A NEW APPROACH IS BEING DEVELOPED THAT USES BULK PROCESSING OF (POSSIBLY) MULTI-SPECTRAL IMAGES TO PROVIDE HIGH PERFORMANCE WITH RELATIVELY SIMPLE HARDWARE. BASIC ALGORITHMS ARE BEING DEMONSTRATED AND EVALUATED VIA COMPUTER SIMULATION, AND PRELIMINARY DESIGN OF A PROCESSOR ARCHITECTURE IS UNDERWAY. DESIGN AND FABRICATION OF A BRASSBOARD PROCESSOR USING LOW-COST COMMERCIAL COMPONENTS WOULD BE UNDERTAKEN IN A LATER PHASE. IN ADDITION TO ITS

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UTILITY IN A LARGE NUMBER OF STRATEGIC DEFENSE SYSTEMS, THIS NEW APPROACH COULD ALSO BE APPLIED TO VARIOUS MILITARY RECONNAISSANCE, SURVEILLANCE AND INTELLIGENCE SYSTEMS, INCLUDING THOSE FOR CRUISE-MISSILE DETECTION, AS WELL AS TO COMMERCIAL ROBOTICS SYSTEMS.

SPACE POWER INC  
1977 CONCOURSE DR  
SAN JOSE, CA 95131  
CONTRACT NUMBER:  
E J BRITT  
TITLE:  
IMPROVED FLIGHT-TYPE ARCJET POWER CONDITIONER  
TOPIC# 6 OFFICE:

ALTHOUGH SEVERAL RESEARCH EFFORTS ARE CONCENTRATING ON DEVELOPMENT OF ARCJET THRUSTERS FOR ELECTRIC PROPULSION APPLICATIONS, RELATIVELY LITTLE WORK IS ADDRESSING THE POWER SUPPLY ELECTRONICS REQUIRED TO OPERATE THESE THRUSTERS. EXPERIMENTS ON ARCJETS TYPICALLY HAVE USED LARGE LABORATORY POWER SUPPLIES, WHICH ARE INAPPROPRIATE FOR ANY SPACE SYSTEM DESIGN. THE TYPE OF POWER CONDITIONING UNIT NEEDED FOR ARCJET OPERATION MUST BE CAPABLE OF CONTROLLING THE CURRENT INTO THE UNSTABLE CURRENT-VOLTAGE CHARACTERISTIC OF AN ARC, WHICH HAS NEGATIVE RESISTANCE. AN IMPROVED FLIGHT-TYPE ARCJET POWER CONDITIONER, WHICH IS BASED ON A MULTI-PHASE BUCK REGULATOR CONCEPT, IS BEING DESIGNED FOR CONTROL OF 30 KWE ARCJET THRUSTERS. HIGH FREQUENCY SWITCHING OF THE CURRENTS THROUGH A GROUP OF PARALLEL INDUCTORS CONTROLS THE CURRENT INTO THE ARCJET LOAD. THE DESIGN INCORPORATES SEVERAL INNOVATIONS FOR HIGH EFFICIENCY AND COMPACT, LIGHTWEIGHT PACKAGING. A REDUCED POWER BREADBOARD UNIT IS BEING BUILT AND TESTED USING ARCJETS UNDER DEVELOPMENT. A FLIGHT-TYPE DESIGN, WHICH INCORPORATES THE ADVANCED FEATURES OF THE BREADBOARD UNIT, IS ALSO BEING PREPARED. IF THE BREADBOARD SUCCESSFULLY DEMONSTRATES OPERATION BY REDUCED POWER AND VERIFIES THE POTENTIAL FOR SCALE-UP TO FULL POWER OPERATION, THE FLIGHT DESIGN WOULD BE CONSTRUCTED AND OPERATED DURING A LATER PHASE.

SPACE POWER INC  
1977 CONCOURSE DR  
SAN JOSE, CA 95131  
CONTRACT NUMBER:  
JOHN L LAWLESS  
TITLE:  
SHORT WAVELENGTH HIGH POWER SPACE-BASED LASER  
TOPIC# 1 OFFICE:

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THE FEASIBILITY IS BEING INVESTIGATED OF A NEW CLASS OF LASERS TO ADDRESS THE NEED FOR HIGH POWER, SHORT WAVELENGTH, EFFICIENT SPACE-BASED LOW MASS LASERS. SIMULATION AND EXPERIMENTS ARE BEING PERFORMED TO DETERMINE THE FEASIBILITY OF PUMPING THE PROPOSED LASER AND ACHIEVING A THRESHOLD LASER INVERSION AND TO PROVE THE EXISTENCE AND STUDY THE PROPERTIES OF THE THEORETICALLY PREDICTED MOLECULAR ENERGY LEVELS BY OBSERVING THEIR SPECTRA IN A LABORATORY. A PRELIMINARY DETERMINATION IS BEING MADE OF THE FEASIBILITY OF AN EXIONIMER LASER FROM THEORETICAL MODELS OF REACTION KINETICS, PUMPING KINETICS, AND ABSORPTION. IF SUCCESSFUL, THIS NEW CLASS OF LASERS WILL MAKE SATELLITES NEEDED FOR STRATEGIC MISSILE DEFENSE MUCH LIGHTER AND HENCE LESS EXPENSIVE. SMALLER VERSIONS OF THESE LASERS ALSO HAVE POTENTIAL COMMERCIAL APPLICATIONS IN LASER CUTTING, WELDING, AND MATERIALS PROCESSING.

SPACE POWER INC  
1977 CONCOURSE DR  
SAN JOSE, CA 95131  
CONTRACT NUMBER:  
H S RHEE  
TITLE:  
HIGH SURVIVABILITY LOW POWER LOW COST SPACE POWER SUPP  
TOPIC# 4                      OFFICE:

THE NEED EXISTS FOR A HIGHLY SURVIVABLE, LOW COST, SPACE NUCLEAR ELECTRIC POWER SUPPLY THAT WILL BE CAPABLE OF DELIVERING 6 KWE OF STEADY POWER FOR LONG PERIODS OF TIME WITH HIGH RELIABILITY. ANY CANDIDATE SPACE POWER SUPPLY SYSTEM MUST SURVIVE SEVERE ENVIRONMENTAL CONDITIONS, INCLUDING NATURAL RADIATION IN ORBIT, MICROMETEORITES, AND DEBRIS AS WELL AS HOSTILE THREATS SUCH AS GROUND AND SPACE-BASED LASERS, KINETIC KILL SYSTEMS AND NUCLEAR WEAPONS. THE PRIMARY SOLUTION TO POWER SYSTEM SURVIVABILITY ARE SMALL SIZE AND RADIATION AND TEMPERATURE RESISTANT CONSTRUCTION. TO ADDRESS THIS ISSUE THE FEASIBILITY IS BEING EXAMINED OF PROVIDING A VERY HIGH SURVIVABILITY SPACE POWER UNIT IN THE RANGE OF 1 TO 10 KWE. THE UNIT WOULD CONSIST OF A SHIELDED, SMALL NUCLEAR REACTOR AND STATIC THERMIONIC POWER CONVERSION SYSTEM. THE POWER SYSTEM WOULD HAVE NO MOVING PARTS DURING OPERATION (STATIC) AND WOULD WEIGH LESS THAN 500 KGM FOR A 7 YEAR LIFE SYSTEM. THE CONCEPT IS EXPECTED TO HAVE AMPLE CONTROL AND SAFETY FOR

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SAFE GROUND HANDLING, LAUNCH, ABORT, STARTUP, OPERATION, AND SHUTDOWN. THE METHOD AND MATERIALS OF HEAT TRANSPORT BEING DEMONSTRATED COULD HAVE APPLICATIONS FROM COOLING HYPERSONIC LEADING EDGES IN TRANSATMOSPHERIC FLIGHT TO VERY HIGH TEMPERATURE, HIGH POWER, COMPACT, SPACE-BORNE KLYSTRONS AND OTHER HIGH TEMPERATURE COMPONENTS AT TEMPERATURES FROM 1800K TO 2100K.

SPACE POWER INC  
1977 CONCOURSE DR  
SAN JOSE, CA 95131  
CONTRACT NUMBER:  
H S RHEE  
TITLE:  
CONTAINING A 5000K PLASMA AT 40 TO 100 ATMOSPHERIC PRE  
TOPIC# 4 OFFICE:

A CLOSED CYCLE GIGAWATT ELECTRIC SPACE POWER SYSTEM THAT UTILIZES A VERY HIGH TEMPERATURE 5000K PLASMA REACTOR AND A MAGNETO HYDRODYNAMIC POWER CONVERSION SYSTEM THAT CAN REJECT HEAT AT TEMPERATURES JUST BELOW 2000K COULD PROVIDE GIGAWATT POWER LEVELS, IN THE ORDER OF 10 KWE/KG, FOR SEVERAL KILO SECONDS. A KEY FEASIBILITY ISSUE IS THE NEED TO CONTAIN THE 5000K (SUN LIKE) PLASMA AT 40 TO 100 ATMOSPHERES PRESSURE IN A REFLECTOR MODERATED, VAPOR FILLED CAVITY CORE REACTOR. TO ADDRESS THIS NEED, THE FEASIBILITY IS BEING DEMONSTRATED OF PRESERVING THE INTEGRITY OF THE STRUCTURAL INNER WALL THAT FACES THE HOT PLASMA. THE APPROACH BEING USED IS TO PROTECT THE REFRACTORY METAL INNER WALL BY AN ABLATING FILM OF LIQUID LITHIUM THAT EVAPORATES INTO THE CAVITY TO BECOME THE WORKING FLUID OF THE CYCLE.

SPACE POWER INC  
1977 CONCOURSE DR  
SAN JOSE, CA 95131  
CONTRACT NUMBER:  
DR JOHN L LAWLESS  
TITLE:  
REDUCTION OF ARCJET CATHODE DEGRADATION  
TOPIC# 6 OFFICE:



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OPERATIONAL EXPERIENCE WITH LABORATORY ARCJETS HAS SHOWN THAT DEGRADATION OF THE CATHODE TIP IS A MAJOR LIFETIME LIMITING PROCESS. HIGH CURRENT DENSITIES AT THE TIP OF THE CATHODE IN A CONSTRICTED ARC THRUSTER LEAD TO EXTREME HEATING, EROSION AND EVEN POSSIBLE LOCAL MELTING. AT THE BEGINNING OF OPERATION, THE CATHODE TIP IS USUALLY SHAPED AS A POINTED ROD; BUT AFTER SOME OPERATING HOURS THE SHARP TIP WILL BE ROUNDED, OR IN SOME CASES ERODED INTO A CONCAVE SHAPE. MODIFYING THE TIP OF AN ARCJET CATHODE BY USING SOME NEW MATERIAL IS EXPECTED TO MAKE THE CATHODE MORE STABLE UNDER OPERATION AND EXTEND THE LIFETIME FOR ARCJET OPERATION. TO ADDRESS THIS PROBLEM, A CATHODE TIP COMPOSED OF AN ADVANCED REFRACTORY COMPOUND IS BEING USED. BOTH ANALYTICAL AND EXPERIMENTAL METHODS ARE BEING EMPLOYED TO SELECT PROMISING MATERIALS FOR THE CATHODE TIP. PROMISING CANDIDATES ARE BEING SCREENED BY OPERATING A TEST SAMPLE OF THE MATERIAL AS A CATHODE IN A TEST ARC, AND A DEMONSTRATION TEST USING THE ADVANCED CATHODE IN AN ARJET IS BEING PLANNED.

SPACE TECH CORP  
2324 MANCHESTER CT  
FORT COLLINS, CO 80526  
CONTRACT NUMBER:  
MICHAEL ANDREWS  
TITLE:  
META COMPILER FOR VERY HIGH LEVEL LANGUAGE IN BATTLE  
MANAGEMENT  
TOPIC# 10                      OFFICE:

ANY VERY HIGH LEVEL LANGUAGE (VHLL) FOR STRATEGIC DEFENSE REQUIRES A COMPILER. NEW META COMPILERS USING ADVANCED ARTIFICIAL INTELLIGENCE METHODS ARE BEING STUDIED SO THAT EVENTUAL VHLL APPLICATION SOFTWARE CAN BE EFFECTIVELY PORTED TO THE SEVERAL GROUND-BASED/SATELLITE-BASED MACHINES. TO DO SO REQUIRES A META COMPILER THAT CAN COMPILE CODE TO DIVERSE ARCHITECTURES. RESEARCH WITH META COMPILERS DEMONSTRATES THAT SUCH AN APPROACH IS FLEXIBLE ENOUGH FOR THE DEVELOPMENT AND TESTING OF EXTREMELY LARGE SOFTWARE SYSTEMS FOR STRATEGIC DEFENSE MISSIONS. ENHANCEMENTS ARE BEING DETERMINED TO META COMPILER THEORY IN SUPPORTING VHLLS. SUCH DEVELOPMENTS WOULD ADD IMPETUS TO MANY POTENTIAL VHLL APPLICATIONS IN SOFTWARE. IF THE INITIAL EFFORT ADDS PROOF-OF-CONCEPT MOMENTUM TO THESE PROMISING IDEAS, THERE IS A BROAD

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COMMERCIAL MARKET IN BOTH LARGE SCALE SOFTWARE SYSTEMS AND HARDWARE SYSTEMS.

SPARTA INC  
23041 AVENIDA de la CARLOTA  
LAGUNA HILLS, CA 92653  
CONTRACT NUMBER:  
GEORGE A LESIEUTRE  
TITLE:  
HIGH DAMPING GRAPHITE FIBER  
TOPIC# 13                      OFFICE:

AN ORDER OF MAGNITUDE INCREASE IN PASSIVE STRUCTURAL DAMPING IS NEEDED TO GUARANTEE THE OPERATIONAL ROBUSTNESS OF RETARGETING STRATEGIC DEFENSE SPACECRAFT. FOR CONTINUOUSLY-JOINED PRECISION STRUCTURES OPERATING IN THE VACUUM OF SPACE, MATERIAL DAMPING WILL BE THE DOMINANT SOURCE OF STRUCTURAL DAMPING. ALTHOUGH HIGH DAMPING NON-STRUCTURAL MATERIALS EXIST, THEIR USE RESULTS IN UNDESIRABLE WEIGHT INCREASES. GRAPHITE-REINFORCED COMPOSITE MATERIALS ARE IDEAL FOR USE IN THESE STRUCTURES BECAUSE OF THEIR TAILORABLE ULTRAHIGH SPECIFIC STIFFNESS AND THERMAL DIMENSIONAL STABILITY. THE HIGH RELATIVE MODULUS OF GRAPHITE CAUSES MOST OF THE COMPOSITE STRAIN ENERGY TO BE FOUND IN THE GRAPHITE. BECAUSE CONSTITUENT CONTRIBUTIONS TO COMPOSITE DAMPING ARE WEIGHTED BY THEIR CONTRIBUTION TO STRAIN ENERGY, THIS LEVERAGE INDICATES THAT EFFORTS TO INCREASE COMPOSITE MATERIAL DAMPING SHOULD FOCUS ON THE GRAPHITE FIBERS IS BEING ESTABLISHED. THE FEASIBILITY OF DEVELOPING HIGH DAMPING GRAPHITE FIBERS. FIBER DAMPING TEST TECHNIQUES ARE BEING DEVELOPED AND EXISTING GRAPHITE FIBERS CHARACTERIZED. KNOWN FIBER CHARACTERISTICS ARE BEING CORRELATED WITH DAMPING RESULTS. MODELS THAT RELATE THE CONTROLLABLE ASPECTS OF GRAPHITE MICROSTRUCTURE AND COMPOSITION TO ITS BULK DESIGN PROPERTIES ARE BEING DEVELOPED. THESE MODELS ARE BEING USED TO ASSESS THE FEASIBILITY OF DEVELOPING HIGH DAMPING GRAPHITE REINFORCEMENT.

SPARTA INC  
1055 WALL ST - STE 208  
LA JOLLA, CA 92037  
CONTRACT NUMBER:  
MORENO WHITE  
TITLE:  
GROUND BASED ELECTROMAGNETIC LAUNCHED PROJECTILE FOR M  
INTERCEPTS  
TOPIC# 2                      OFFICE:

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FEASIBILITY OF USING A GROUND-BASED, ELECTROMAGNETIC (EM) LAUNCHED PROJECTILE FOR EXO MIDCOURSE INTERCEPT IS BEING INVESTIGATED. BASED ON ERIS TYPE ENGAGEMENT SCENARIOS, THIS PROGRAM IS DEFINING SYSTEM-RELATED CRITICAL ISSUES AS WELL AS MATERIAL/MECHANICAL TECHNOLOGIES ISSUES. THE FOCUS OF THE INVESTIGATION IS THE EM LAUNCHER PERFORMANCE REQUIREMENTS INCLUDING POINTING ACCURACY, TRAJECTORY OPTIMIZATION, AND POWER REQUIREMENTS AS WELL AS MATERIAL ISSUES ASSOCIATED WITH HYPERVELOCITY PROJECTILES IN THE SENSIBLE ATMOSPHERE. OVERALL SYSTEM EFFECTIVENESS IS BEING EVALUATED AND TECHNOLOGY REQUIREMENTS DEFINED IN ORDER TO COMPLETE THE FEASIBILITY DEMONSTRATION OF THE GROUND-BASED EM LAUNCHED MIDCOURSE INTERCEPTOR. IF SUCCESSFUL, THIS RESEARCH WOULD PROVIDE A MULTISHOT INTERCEPTOR CAPABILITY WHICH COULD OFFER SIGNIFICANT COST REDUCTION PER INTERCEPTOR. IMPROVED EFFECTIVENESS RESULTING FROM HIGH AVERAGE VELOCITIES AND AN INHERENTLY ROBUST SYSTEM COULD RESULT. A GROUND-BASED EM LAUNCHED INTERCEPTOR COULD IMPROVE THE AFFORDABILITY AND EFFECTIVENESS OF THE STRATEGIC DEFENSE IN DEPTH DEFENSIVE SYSTEM.

SPARTA INC  
1055 WALL ST - STE 208  
LA JOLLA, CA 92038  
CONTRACT NUMBER:  
IRVING B OSOFSKY  
TITLE:  
GUN-LAUNCHED TARGET VEHICLES FOR SIMULATING BALLISTIC  
TRAJECTORIES  
TOPIC# 2                      OFFICE:

A NUMBER OF FLIGHT TEST PROGRAMS WILL BE REQUIRED TO DEMONSTRATE TECHNICAL FEASIBILITY FOR KEY COMPONENTS OF PROPOSED STRATEGIC DEFENSE SYSTEM ARCHITECTURES. A LOW COST APPROACH IS REQUIRED FOR TARGET VEHICLES OTHER THAN THOSE REQUIRING A FULL-SCALE SIMULATION. A GUN-LAUNCHED MULTIPLE STAGE CHEMICAL ROCKET BOOSTER MIGHT BE USED TO ACCELERATE THE PAYLOAD TO REENTRY VELOCITIES AFTER THE CANNON BOOSTS THE "UPPER STAGES" OUT OF THE LOWER ATMOSPHERE. THIS WOULD RESULT IN A MUCH SMALLER MISSILE. THE FEASIBILITY OF GUN LAUNCHING REENTRY VEHICLES TO TRAJECTORIES WHICH SIMULATE ICBM TRAJECTORIES IS BEING INVESTIGATED. SEVERAL STANDARD 16.7 INCH BORE NAVAL GUNS, WHICH WERE MODIFIED UNDER THE HIGH ALTITUDE RESEARCH PROGRAM AND ARE STILL IN

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GOOD REPAIR, ARE CAPABLE OF LAUNCHING A 2,000+ LB. PAYLOAD AT 4,000 FPS. IF THE PAYLOAD HAS A NUMBER OF POWERED STAGES, PRELIMINARY CALCULATIONS SHOW THAT ICBM TRAJECTORIES CAN BE SIMULATED. MORE DETAILED ANALYSES ARE REQUIRED TO DEFINE THE CAPABILITIES OF THE CONCEPT. PRELIMINARY CALCULATIONS SHOW THAT TARGET VELOCITIES RANGING TO 24,000 FPS AND TRAJECTORY APOGEES RANGING TO 300 NAUTICAL MILES ARE ACHIEVABLE. LAUNCH ACCELERATION IS REDUCED TO TOLERABLE LEVELS BY THE EXTREMELY LONG BARREL AND SLOW BURNING PROPELLANT. SUCCESSFUL ROCKET LAUNCHES WERE MADE WITH THESE GUNS AND ROCKET ASSISTED AND GUIDED ARTILLERY PROJECTILES ARE NOW STATE OF THE ART.

SPIRE CORP  
PATRIOTS PK  
BEDFORD, MA 01730  
CONTRACT NUMBER:  
JAMES K HIRVONEN  
TITLE:  
SELF LUBRICATING CERAMICS BY ION ENHANCED DEPOSITION  
TOPIC# 13 OFFICE:

EFFECTIVE HIGH TEMPERATURE SOLID LUBRICANTS FOR CERAMIC SURFACES HAVE BEEN RECENTLY DEMONSTRATED USING ION BEAM MIXING OF Ni AND Ti FILMS ON Si<sub>3</sub>N<sub>4</sub> SURFACES. THE LUBRICITY OF THESE SURFACES IS ATTRIBUTED TO THE FORMATION OF QUASI-LIQUID OXIDES AT ELEVATED TEMPERATURES. A PRIME QUESTION REMAINS OF HOW ENDURABLE THESE SURFACE COATINGS WILL BE FOR LONG TERM OPERATION. THE FEASIBILITY OF COMBINING TWO INDEPENDENTLY DEMONSTRATED CONCEPTS TO PRODUCE NOVEL BUILT-IN SOLID LUBRICANTS FOR CERAMIC SURFACES CAPABLE OF OPERATING AT HIGH TEMPERATURES IS PROPOSED. THE METHOD IS TO EMPLOY THE SIMULTANEOUS DEPOSITION OF Si WITH CONCURRENT N<sup>+</sup> ION BOMBARDMENT TO FORM Si<sub>3</sub>N<sub>4</sub> ALONG WITH THE CONTROLLED INCORPORATION OF ELEMENTS (Ni, Ti) SHOWN TO FORM EFFECTIVE SOLID LUBRICANTS (OXIDES) ON CERAMICS AT HIGH TEMPERATURES. THIS BUILT-IN SOLID LUBRICANT COULD BE INCORPORATED TO ARBITRARY DEPTHS AND CONCENTRATIONS AND USED ON CONVENTIONAL Si<sub>3</sub>N<sub>4</sub> BEARING SURFACES WITHOUT DELAMINATION PROBLEMS. A SELF GENERATING SOLID LUBRICANT FOR HIGH TEMPERATURE CERAMIC SURFACES WOULD HAVE IMMEDIATE APPLICATION FOR CERAMIC BEARINGS.

SPIRE CORP  
PATRIOTS PK  
BEDFORD, MA 01730  
CONTRACT NUMBER:  
ANTON C GREENWALD  
TITLE:  
HYDROGENATED AMORPHOUS SILICON ALLOYS FOR REVERSIBLE H  
SWITCH MATERIALS  
TOPIC# 5 OFFICE:

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HYDROGENATED AMORPHOUS SILICON (A-Si:H) IS A THIN FILM SEMICONDUCTOR MATERIAL WHICH TYPICALLY EXHIBITS A MILLIONFOLD REDUCTION IN RESISTIVITY WHEN ILLUMINATED WITH 0.1 WATT/CM<sup>2</sup> VISIBLE LIGHT. THIS MATERIAL HAS BEEN RESEARCHED EXTENSIVELY FOR USE IN SOLAR CELLS AND LOW VOLTAGE SWITCHING APPLICATIONS (THIN FILM TRANSISTORS) BUT NO WORK HAS BEEN PUBLISHED ON HIGH VOLTAGE BEHAVIOR. A GEOMETRY HAS BEEN DEvised FOR EASILY CONSTRUCTING A COMPOSITE SOLID WITH MANY LAYERS OF A-Si:H WHICH MAY HOLD OFF AN ELECTRIC FIELD OF 100 KV/CM AND WHICH MAY EXHIBIT REVERSIBLE CONDUCTION WHEN IRRADIATED BY A LIGHT PULSE. THE DIELECTRIC STRENGTH OF THIS MATERIAL IS BEING DETERMINED AS A FUNCTION OF ALLOY (Si, C, Ge) COMPOSITION, DOPING AND FILM THICKNESS. THE RISE TIME FOR OPTICALLY TRIGGERED SWITCHES WITH A SINGLE LAYER OF MATERIAL IS BEING MEASURED. AT A LATER RESEARCH STAGE, THIS PROGRAM WOULD MEASURE THE SURFACE FLASHOVER RESISTANCE OF THIS MATERIAL IN VARYING ENVIRONMENTS, STRUCTURAL CHANGES AS A FUNCTION OF CURRENT DENSITY AND NUMBER OF CYCLES, AND DETERMINE THE FEASIBILITY OF SIMPLE MULTILAYERED STRUCTURES TO INCREASE THE OPERATING VOLTAGE. IF SUCCESSFUL, THIS RESEARCH WILL PRODUCE A SOLID STATE OPTICALLY TRIGGERED HIGH VOLTAGE SWITCH WITH LONG LIFETIME AND HIGH REPETITION RATES.

SPIRE CORP  
PATRIOTS PK  
BEDFORD, MA 01730  
CONTRACT NUMBER:  
STANLEY M VERNON  
TITLE:  
DEPOSITION OR InP ON Si SUBSTRATES FOR MONOLITHIC INTE  
ADVANCED ELECTRONICS  
TOPIC# 14                      OFFICE:

A PROCESS IS BEING DEVELOPED FOR THE HETEROEPI TAXIAL GROWTH OF InP ON SILICON SUBSTRATES BY METALORGANIC CHEMICAL VAPOR DEPOSITION. DUE TO ITS ELECTRON SATURATED DRIFT VELOCITY AND RADIATION RESISTANCE, InP IS AN EXCELLENT MATERIAL FOR USE IN HIGH SPEED ELECTRON DEVICES AND SPACE APPLICATIONS. SILICON IS AN OPTIMAL SUBSTRATE MATERIAL DUE TO THE AVAILABILITY OF HIGH PURITY, LARGE AREA, LOW COST WAFERS. COMPARED TO InP, Si HAS VERY HIGH STRENGTH-TO-WEIGHT RATIO AND THERMAL CONDUCTIVITY. THE GROWTH PROCESS BEING DEVELOPED WOULD PROVIDE HIGH QUALITY, SINGLE CRYSTAL InP ON Si THAT COULD LEAD TO THE ESTABLISHMENT

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OF AN InP-ON-Si DEVICE TECHNOLOGY. IN THE INITIAL RESEARCH EFFORT, THE FEASIBILITY IS BEING DEMONSTRATED OF DEPOSITING SINGLE-CRYSTAL FILMS OF InP ONTO Si SUBSTRATES AND THE STRUCTURAL PROPERTIES OF THESE FILMS CHARACTERIZED. OPTIMIZATION OF THE GROWTH PARAMETERS AND DEMONSTRATION OF DEVICE-QUALITY MATERIAL WOULD BE SUBJECTS OF A LATER RESEARCH EFFORT. THE DEVELOPMENT OF A GROWTH PROCESS FOR InP ON SILICON WOULD PROVIDE A STRONG BASIS FOR THE DEVELOPMENT OF LARGE SCALE INTEGRATION OF HIGH SPEED, RADIATION HARD InP DEVICES ON HIGH QUALITY, LOW COST, LARGE AREA SUBSTRATES. THE DEVELOPMENT OF DEVICE QUALITY InP ON SILICON COULD BE EFFECTIVELY UTILIZED IN TRANSISTORS, PHOTODETECTORS, LASERS, MICROWAVE COMMUNICATIONS DEVICES, AND THE MONOLITHIC INTEGRATION OF InP OPTOELECTRONIC DEVICES WITH SILICON LOGIC CIRCUITS.

SPIRE CORP  
PATRIOTS PK  
BEDFORD, MA 01730  
CONTRACT NUMBER:  
STEPHEN BUNKER  
TITLE:  
DIAMOND FILMS BY ION BEAM DEPOSITION  
TOPIC# 14                      OFFICE:

DIAMOND FILMS HAVE CONSIDERABLE IMPORTANCE FOR ADVANCED HIGH-TEMPERATURE POWER ELECTRONICS AND SENSORS, HIGH FREQUENCY OPERATION AND EXTREME RADIATION HARDNESS. A NEW FABRICATION TECHNIQUE FOR DEPOSITION OF DIAMOND FILM IS BEING INVESTIGATED WHICH HAS THE POTENTIAL OF PROVIDING ORDERED CRYSTAL FORMATION. SUCH A STRUCTURE COULD BE PRODUCED ON A SILICON SUBSTRATE, THUS PERMITTING INTEGRATION OF STANDARD SILICON PROCESSING TECHNOLOGY WITH DIAMOND FILM DEVICES. HIGH VOLTAGE ISOLATION IS BEING FABRICATED FOR AN EXISTING WAFER MOUNT, AND A DECELERATING ELECTRODE LENS CONSTRUCTED FOR AN EXISTING ION BEAM SYSTEM TO CREATE THE LOW ENERGY BEAM AND TARGET ASSEMBLY. EXISTING WAFER ASSEMBLY AND AUXILIARY GAS FLOW SYSTEM ARE BEING INSTALLED. THE EFFECT OF SILICON SUBSTRATE SURFACE MORPHOLOGY ON DIAMOND CRYSTAL GROWTH IS BEING TESTED. THE EFFECT ON DIAMOND FILM GROWTH OF A CUBIC BORON NITRIDE COATING ON A SILICON SUBSTRATE IS BEING TESTED. THE RESULTING SURFACE AND CRYSTAL MORPHOLOGY IS BEING ANALYZED AND THE QUALITY OF THE FILMS GRADED. DIAMOND FILMS RECENTLY

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HAVE ATTRACTED CONSIDERABLE INTEREST NOW THAT OTHER RESEARCH HAS DEMONSTRATED THAT DOPED LAYERS CAN BE FABRICATED. THIS SUGGESTS A WIDE RANGE OF KEY SEMICONDUCTOR APPLICATIONS DUE TO HIGH ELECTRON MOBILITY, HIGH TEMPERATURE OPERATION, EXCELLENT THERMAL CONDUCTIVITY, AND UNEQUALED RADIATION HARDNESS OF DIAMOND FILMS.

SPIRE CORP  
PATRIOTS PK  
BEDFORD, MA 01730  
CONTRACT NUMBER:  
STEPHEN N BUNKER  
TITLE:  
ION BEAM DEPOSITION OF SILICON-ON-INSULATOR  
TOPIC# 14                      OFFICE:

SILICON-ON-INSULATOR SUBSTRATES HAVE GREAT IMPORTANCE FOR THE NEXT GENERATION OF SEMICONDUCTOR DEVICES. ALTHOUGH MANY COMPETING TECHNOLOGIES HAVE BEEN INVESTIGATED, ALL HAVE BEEN SHOWN TO BE COSTLY, HAVE TECHNICAL PROBLEMS, OR REQUIRE MAJOR BREAKTHROUGHS IN HARDWARE DESIGN FOR COMMERCIALIZATION. A METHOD IS BEING INVESTIGATED THAT USES THE SPECIAL PROPERTIES OF ION BEAM DEPOSITION TO GROW THIN SINGLE CRYSTAL SILICON FILMS ON INSULATORS. THIS METHOD PERMITS A VARIETY OF INSULATOR THICKNESSES TO BE USED AND PERMITS RELATIVELY LOW TEMPERATURE PROCESSING, ADMITTING THE POSSIBILITY OF THREE DIMENSIONAL DEVICE STRUCTURES. HIGH VOLTAGE ISOLATION IS BEING FABRICATED FOR AN EXISTING WAFER MOUNT AND A DECELERATING ELECTRODE LENS CONSTRUCTED FOR AN EXISTING ION BEAM SYSTEM TO CREATE THE LOW ENERGY BEAM AND TARGET ASSEMBLY. EPITAXIAL GROWTH CONDITIONS ARE BEING DEMONSTRATED ON A BARE SILICON WAFER. RADIAL GROWTH PATTERN IS BEING DEMONSTRATED FROM A CENTRAL SEED WHEN THE WAFER IS ROTATED AND RADIALY TRANSLATED. CRYSTALLINITY OF THE RESULTANT THIN FILM AND CRYSTAL ORIENTATION IS BEING VERIFIED AT REPRESENTATIVE SITES.

SPIRE CORP  
PATRIOTS PK  
BEDFORD, MA 01730  
CONTRACT NUMBER:  
BRIAN W MURRAY  
TITLE:  
METALLIC LIGHT ABSORBING DURABLE OPTICAL BAFFLE MATERIAL  
TOPIC# 8                      OFFICE:

AD-A195 729

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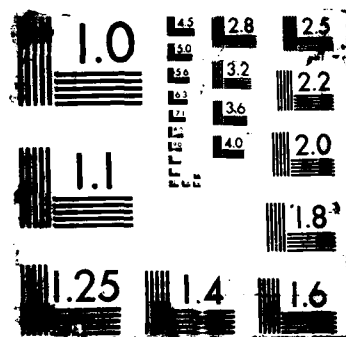
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AN OPTICAL BAFFLE MATERIAL IS BEING DEVELOPED THAT IS METALLIC, LIGHT ABSORBING, RADIATION-HARDENED AND DURABLE. INITIAL EXPERIMENTS HAVE DEMONSTRATED THAT A STRUCTURED BE SPUTTERED LAYER CAN BE DEPOSITED ON PROPERLY PREPARED BE SUBSTRATES. THE STRUCTURE IS IN THE FORM OF LIGHT ABSORBING SPIRES WITH HIGH ASPECT RATIOS. OPTIMIZATION OF THE PROCESS IS BEING PERFORMED ON 1-INCH DIAMETER COUPONS WITH COMPLETE CHARACTERIZATION OF EACH PROCESS STEP. THE BAFFLE MATERIAL IS BEING CHARACTERIZED AND COMPARED TO AVAILABLE BAFFLE MATERIAL USING BIDIRECTIONAL REFLECTANCE DISTRIBUTION FUNCTION MEASUREMENTS AND SIMULATIONS OF THE EFFECTS OF RAM OXYGEN AND MICROMETEORITE SHOWERS. SCALING UP THE DEVELOPED PROCESS TO SYSTEM-SIZED BAFFLE COMPONENTS WILL BE ADDRESSED AT A LATER EFFORT. THIS PROCESS DEVELOPMENT, IF SUCCESSFUL, WILL ALLOW THE MANUFACTURE OF A NEW BAFFLE MATERIAL WHICH, WHEN EMPLOYED, WILL EXTEND THE USEFUL LIFE AND INCREASE THE RELIABILITY OF SENSITIVE, SPACE-BASED, OPTICAL SYSTEMS.

SPIRE CORP  
PATRIOTS PK  
BEDFORD, MA 01730  
CONTRACT NUMBER:  
STEPHEN N BUNKER  
TITLE:  
MULTIPLE ION IMPLANTATION OF BURIED LAYERS FOR SILICON  
TOPIC# 14                      OFFICE:

FABRICATING SILICON-ON-INSULATOR (SOI) SUBSTRATE IS A SUBJECT OF KEEN INTEREST BECAUSE OF THE WIDE VARIETY OF MAJOR ELECTRICAL BENEFITS THAT CAN BE OBTAINED FOR INTEGRATED CIRCUITS. THE MOST PROMISING TECHNOLOGY IS ION IMPLANTATION OF BURIED LAYERS BECAUSE OF PROCESS CONTROLLABILITY, MILD DEFECTS, AND LARGE AREA UNIFORMITY. COMPLEX DEVICE FABRICATION HAS BEEN SUCCESSFULLY DEMONSTRATED. THE IMPLANTATION TECHNIQUE LENDS ITSELF TO A VARIETY OF NOVEL PROCESS MODIFICATIONS TO ENHANCE THE PERFORMANCE OF THE BASIC SOI MATERIAL. METHODS ARE BEING INVESTIGATED FOR CREATING MUCH HIGHER VOLTAGE ISOLATION THAN NORMALLY AVAILABLE AND SIGNIFICANTLY DECREASED PARASITIC CAPACITANCE. A UNIQUE MULTIPLE ION IMPLANT PROCESS IS BEING USED TO FABRICATE THE MATERIAL. THE SILICON-ON-INSULATOR SUBSTRATES BEING FABRICATED ARE ESPECIALLY USEFUL FOR MIXING VERY HIGH VOLTAGE CIRCUIT ELEMENTS WITH CONTROL STRUCTURES. THIS IS IMPORTANT FOR

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RADIATION-HARD POWER CONTROL DEVICES. THE DECREASED PARASITIC CAPACITANCE GEOMETRY IS IMPORTANT FOR INCREASING DEVICE SPEED, DECREASING GATE THRESHOLD SENSITIVITY TO SUBSTRATE BIAS, AND CORRECTING THE KINK FREQUENTLY OBSERVED IN THE CHARACTERISTIC DEVICE CURVES.

SRS TECHNOLOGIES  
990 EXPLORER BLVD NW  
HUNTSVILLE, AL 35806  
CONTRACT NUMBER:  
KEITH NOREN  
TITLE:  
DISCRIMINATION THROUGH REALTIME LEARNING  
TOPIC# 3                      OFFICE:

THE PROBLEM OF DISCRIMINATING TRUE REENTRY VEHICLES CONTAINING NUCLEAR WARHEADS FROM DECOYS IN THE MIDCOURSE REGIME IS AN ACKNOWLEDGED CRITICAL ISSUE. VARIOUS SENSORS HAVE BEEN PROPOSED TO MEASURE SPECIFIC PHENOMENA WHICH MIGHT BE USEFUL. IT WOULD BE DESIRABLE TO USE REALTIME LEARNING (RTL) APPROACHES TO CONTINUALLY SHARPEN THESE SENSORS' CAPABILITIES TO PERFORM THE DISCRIMINATION FUNCTION. THE FEASIBILITY IS BEING INVESTIGATED OF USING REALTIME LEARNING TO ENHANCE PASSIVE DISCRIMINATION. OPTIONS FOR KILL ASSESSMENT SENSORS THAT DETERMINE NOT ONLY IF A TARGET HAS BEEN KILLED, BUT ALSO THE LETHALITY OF THAT TARGET ARE BEING INVESTIGATED. THREE APPLICATIONS OF RTL ARE BEING STUDIED: CORRECTING DATABASE INACCURACIES; DETERMINING EFFECTIVE DISCRIMINANTS; AND RATIONALIZING BATTLE MANAGEMENT ACTIONS AFTER SELF-DIAGNOSIS OF THE DISCRIMINATION FUNCTION. SENSOR, COMMUNICATIONS, ALGORITHM AND DATA RETENTION REQUIREMENTS TO EVOKE RTL ARE ALSO BEING INVESTIGATED. THE RTL ALGORITHMS THEMSELVES ARE BEING DEVELOPED. WORK IN A LATER PHASE WOULD INCLUDE APPLICATIONS OF RTL TO ACTIVE/INTERACTIVE DISCRIMINATION, DEFINITION OF RTL DEMONSTRATION TESTS AND RTL ALGORITHMS APPLIED TO PARTICULAR ARCHITECTURES.

SRS TECHNOLOGIES  
990 EXPLORER BLVD NW  
HUNTSVILLE, AL 35806  
CONTRACT NUMBER:  
BOB PILGRIM  
TITLE:  
SENSOR TO SENSOR CORRELATION ALGORITHM  
TOPIC# 10                      OFFICE:

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AS STRATEGIC DEFENSE ARCHITECTURES DEVELOP, IT IS CLEAR THAT EFFICIENT AND ROBUST METHODS FOR THE COLLECTION AND CORRELATION OF MEASUREMENT DATA FROM MULTIPLE SENSOR PLATFORMS ARE CRITICAL ISSUES. A MAJOR PART OF THE PROBLEM IS DUE TO THE FACT THAT CURRENTLY PROPOSED PLATFORM CORRELATION ALGORITHMS RELY ON THE ASSOCIATION OF TARGET STATE ESTIMATES. THESE ESTIMATES STRESS THE REAL-TIME CAPABILITIES OF THE SENSOR AND DATA PROCESSORS. THE DETERMINATION OF TARGET STATE USING ANGLE-ONLY-TRACK ALGORITHMS IS ITSELF TIME CONSUMING AND SUSCEPTIBLE TO PATHOLOGICAL ENGAGEMENT GEOMETRIES. A SIMPLIFIED PLATFORM-TO-PLATFORM CORRELATION (PPC) ALGORITHM IS BEING EXAMINED THAT WOULD PROVIDE UNAMBIGUOUS PASSIVE MEASUREMENT CORRELATION WITHOUT THE NEED FOR COMPUTATIONALLY EXPENSIVE ANGLE-ONLY-TRACK STATE ESTIMATION. STRATEGIC PLATFORM CORRELATION REQUIREMENTS ARE BEING DEFINED. CAPABILITIES AND LIMITATIONS OF THE PPC ALGORITHM ARE BEING IDENTIFIED. HIGH FIDELITY COMPUTER SIMULATION OF THIS ALGORITHM IS BEING DEVELOPED. FEASIBILITY OF THE PPC ALGORITHM IS BEING DEMONSTRATED. AN OPTICAL COMPUTER TEST PLAN IS BEING DEVELOPED FOR IMPLEMENTATION AT A LATER STAGE. MANY POTENTIAL APPLICATIONS EXIST FOR HIGH SPEED IMAGE CORRELATION IN THE INDUSTRIAL SECTOR. FOR EXAMPLE, THE PPC ALGORITHM COULD BE COUPLED TO A COMMERCIAL IMAGE PROCESSING SYSTEM TO PRODUCE A COMPLETE 3-D AUTOMATIC VISION SYSTEM.

SUPERCON INC  
830 BOSTON TURNPIKE  
SHREWSBURY, MA 01545  
CONTRACT NUMBER:  
DR ERIC GREGORY

TITLE:

CuNb CURRENT CARRYING RAILS WITH IMPROVED EROSION RESISTANCE  
APPLICATIONS IN ELECTROMAGNETIC RAILGUNS

TOPIC# 2                      OFFICE:

HIGH STRENGTH, HIGH CONDUCTIVITY MATERIALS HAVE BEEN MADE BY SCALING UP THE CuNb IN SITU PROCESS ORIGINALLY DEVELOPED FOR SUPERCONDUCTING MATERIALS. A HIGH FIELD PULSE MAGNET CONSTRUCTED OF THIS MATERIAL SET A WORLD RECORD FOR A WIRE WOUND COIL OF 68.4T WHILE MAINTAINING A PULSE HALF PERIOD OF 5.6 MS. CuNb IS ALSO VERY RESISTANT TO ARC DAMAGE WHEN USED AS ELECTRODES IN HIGH CURRENT, HIGH ENERGY TRANSIENT ARCS. BY INCORPORATING A THIN SURFACE LAYER OF REFRACTORY METAL

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CLADDING TO CuNb MICROCOMPOSITE MATERIAL, THE AMOUNT OF RAIL DAMAGE IN ELECTROMAGNETIC RAIL GUNS DUE TO JOULE HEATING, WALL ABLATION, AND SECONDARY ARC FORMATION MAY BE SIGNIFICANTLY REDUCED. HIGH STRENGTH, HIGH CONDUCTIVITY ELECTROMAGNETIC RAILS MADE OF BOTH CLAD AND UNCLAD CUNB ULTRAFINE MICROCOMPOSITE MATERIALS ARE BEING PRODUCED AND THE RESULTS ANALYZED. IF SUCCESSFUL, THIS WORK WILL RESULT IN THE DEVELOPMENT OF A COMMERCIAL PROCESS FOR THE PRODUCTION OF HIGH STRENGTH, HIGH CONDUCTIVITY CURRENT CARRYING RAILS FOR ELECTROMAGNETIC LAUNCHERS POSSESSING MULTISHOT CAPABILITY. DUE TO THEIR STRENGTH, THIS WILL SUBSTANTIALLY REDUCE THE AMOUNT AND, THEREFORE, THE MASS OF RAIL RESTRAINING STRUCTURES CURRENTLY USED ON DEVELOPMENTAL LAUNCHERS.

SYSTEMS & PROCESSES ENGINEERING CORP  
1406 SMITH RD - STE A  
AUSTIN, TX 78721  
CONTRACT NUMBER:  
RANDOLPH E NOSTER  
TITLE:  
OPERATIONS ASSESSMENT MODELING TOOL  
TOPIC# 6                      OFFICE:

AN INDEPENDENT COST EVALUATION MODELING TOOL IS NEEDED FOR LOGISTICS OPERATIONS ASSESSMENT IN THE EFFECTIVE DEVELOPMENT OF ALL LARGE SPACE AND MISSILE SYSTEMS (INCLUDING LAUNCH SYSTEMS FOR COMMERCIAL AND MILITARY PAYLOADS). A COST EFFECTIVENESS MODEL ULTIMATELY WILL PROVIDE THE OVERALL SPACE COMMUNITY WITH THE CAPABILITY TO ESTABLISH SUPPORTABILITY REQUIREMENTS AND TO INTEGRATE LOGISTICS AND OPERATIONS CONSIDERATIONS INTO EFFECTIVE SYSTEM DESIGNS. A PROTOTYPE, SPACE-LOGISTICS-OPERATIONS COST EFFECTIVENESS MODEL IS BEING DEVELOPED TO ADDRESS THIS NEED. STRATEGIC DEFENSE LOGISTICS REQUIREMENTS ARE BEING EVALUATED USING REPRESENTATIVE SCENARIOS. CRITICAL DESIGN, MANUFACTURING, AND LOGISTICS FUNCTIONS ARE BEING IDENTIFIED THAT COULD OR MUST BE IMPROVED THROUGH APPLICATIONS OF ADVANCED TECHNOLOGIES, SUCH AS AUTOMATION, ROBOTICS, AND EXPERT SYSTEMS TECHNOLOGY. LOGISTICS AND MANUFACTURING PROCESS (REQUIREMENTS) MODELS ALSO ARE BEING IDENTIFIED. FIRST ORDER COST TRANSFORMS AND AN ADVANCED TECHNOLOGY ROBOTICS ASSESSMENT MODEL FOR A SELECTED SYSTEM OR SCENARIO ARE BEING DEVELOPED APPLYING LUNAR BASE MODELING TECHNOLOGY. A FIRST ORDER, ADAPTABLE PC-BASED, PROTOTYPE, SPACE-LOGISTICS-OPERATIONS, COST

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EFFECTIVENESS MODEL IS BEING PRODUCED THAT WILL BE DEMONSTRATED TO,  
AND IMMEDIATELY USEABLE BY, GOVERNMENT PERSONNEL.

SYSTEMS ENGINEERING INC  
7833 WALKER DR - STE 308  
GREENBELT, MD 20770  
CONTRACT NUMBER:  
WILLIAM H BENNETT

TITLE:  
ALGORITHM DEVELOPMENT FOR STRATEGIC DEFENSE WEAPONS SY  
ALLOCATION  
TOPIC# 10                      OFFICE:

A SYSTEMATIC INVESTIGATION OF ADVANCED MODELING AND STOCHASTIC CONTROL AND SCHEDULING METHODOLOGIES IS BEING UNDERTAKEN THAT ADDRESSES ONE ASPECTS OF THE WEAPONS ALLOCATION PROBLEM, I.E., SEVERAL PLATFORMS WITH ASSETS OF DIFFERENT CHARACTER DEFENDING AGAINST A DIVERSE COLLECTION OF TARGETS. MODELS FOR SUCH SCENARIOS LEAD TO STOCHASTIC SCHEDULING PROBLEMS WHICH CANNOT BE HANDLED BY CONVENTIONAL ANALYTICAL METHODS. SEVERAL DIFFERENT ANALYTICAL APPROACHES ARE BEING EXPLORED THAT HAVE THE POTENTIAL FOR SYNTHESIS OF EFFECTIVE ENGAGEMENT ALGORITHMS. STOCHASTIC DYNAMICAL MODELS ARE BEING DESIGNED TO REPRESENT THE INTERACTION OF THE WEAPONS PLATFORMS AND THE TARGET SYSTEMS DURING THE POST-BOOST AND MID-COURSE PHASES OF OPERATIONS. BASED ON THESE ENGAGEMENT MODELS, A TWO-STEP APPROACH IS BEING USED TO DEVELOP THE WEAPONS ALLOCATION ALGORITHMS. A PROTOTYPE SET OF ALGORITHMS IS BEING DEVELOPED USING AN OPTIMIZATION METHOD CALLED THE STOCHASTIC GRADIENT METHOD. THE ALGORITHMS COMPUTED BY THIS METHOD IS SERVING AS A BASELINE FOR THE DEVELOPMENT OF MORE REPRESENTATIVE STRATEGIES WHICH REFLECT THE OPERATIONAL STRUCTURE OF THE BATTLE MANAGEMENT (BM) WEAPONS ALLOCATION SYSTEM. STOCHASTIC SCHEDULING MODELS AND A SET OF STRATEGIES CALLED INDEX RULES ARE BEING USED TO DERIVE EFFECTIVE AND EFFICIENT ENGAGEMENT STRATEGIES FOR A BM SYSTEM INVOLVING SEVERAL WEAPONS PLATFORMS RESPONDING TO A LARGE NUMBER OF TARGETS OVER AN EXTENDED REGION OF SPACE.

SYSTEMS ENGINEERING INC  
7833 WALKER DR - STE 308  
GREENBELT, MD 20770  
CONTRACT NUMBER:  
WILLIAM H BENNETT  
TITLE:  
CONTROLLERS FOR SPACE STRUCTURES  
TOPIC# 12                      OFFICE:

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THE UNPRECEDENTED POINTING AND TRACKING ACCURACIES REQUIRED IN STRATEGIC DEFENSE ENGAGEMENT SCENARIOS PRESENT FORMIDABLE CHALLENGES TO THE DESIGNERS OF PLATFORM CONTROL SYSTEMS FOR SLEWING AND VIBRATION SUPPRESSION. IT IS CLEAR THAT CONVENTIONAL DESIGN PROCEDURES BASED ON FINITE DIMENSIONAL, LUMPED PARAMETER MODELS (FINITE ELEMENTS OR MODES) ARE INADEQUATE TO THE TASK. ADVANCED DESIGN METHODS ARE BEING DEVELOPED FOR MODELING AND CONTROL OF FLEXIBLE STRUCTURES. THESE METHODS HAVE THE ANALYTICAL SOPHISTICATION TO TREAT THE VIBRATION SUPPRESSION PROBLEM IN THE DETAIL NECESSARY TO CAPTURE ALL FACTORS RELEVANT TO ACCURATE POINTING REQUIREMENTS. DIRECTIONS EXPLORED IN PREVIOUS WORK ARE BEING DEVELOPED AND EXPANDED TO THE LEVEL THAT SIGNIFICANT ENGINEERING EVALUATION OF CONTROLLERS FOR REALISTIC SPACE STRUCTURE PROBLEMS CAN BE DESIGNED.

TETRA CORP  
4905 HAWKINS ST NE  
ALBUQUERQUE, NM 87109  
CONTRACT NUMBER:  
WILLIAM M MOENY

TITLE:  
SHORT WAVELENGTH CHEMICAL LASER FLUID DYNAMIC AND OPTI  
PERFORMANCE  
TOPIC# 1                      OFFICE:

HISTORICALLY THE SEARCH FOR NEW CHEMICAL LASERS HAS BEEN CHARACTERIZED BY MUCH EMPHASIS AND RESEARCH IN THE CHEMISTRY AND KINETICS OF THE CANDIDATES WITH THE EXAMINATION OF THE FLUID DYNAMICS AND OPTICAL QUALITY ALMOST AS AN AFTERTHOUGHT. MORE OF A SYSTEMS APPROACH NEEDS TO BE APPLIED TO THE RESEARCH OF SHORT WAVELENGTH CHEMICAL LASER (SWCL) CONCEPTS SO THAT THE FLUID DYNAMIC AND OPTICAL PHENOMENA ARE INVESTIGATED CONCURRENTLY WITH THE CHEMISTRY AND KINETICS. SUCH AN APPROACH IS EXPECTED TO SAVE TIME IN THE DEVELOPMENT PROCESS, AND THEREBY REDUCE COSTS AND PRODUCE A BETTER LASER. ELEVEN SPECIFIC SWCL PROJECTS CURRENTLY UNDERWAY ARE BEING EXAMINED TO INCREASE UNDERSTANDING OF PULSED SWCL FLUID DYNAMICS ALONG WITH THE RESULTANT OPTICAL IMPLICATIONS. A GENERIC LASER DESIGN IS BEING DERIVED APPROPRIATE FOR THE MAJORITY OF THE CONCEPTS AND LASER DESIGNS ARE BEING ORIGINATED FOR SPECIFIC CONCEPTS. THE ACCOMPLISHMENT OF THESE OBJECTIVES WILL PROVIDE SCREENING CRITERIA (PROJECTED FLUID DYNAMIC

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AND OPTICAL PERFORMANCE) TO EVALUATE AND RANK SUCH CONCEPT  
FEASIBILITY. A FOUNDATION WILL BE ESTABLISHED FOR SIMPLE LOW COST  
FLUID DYNAMIC EXPERIMENTS FOR BOTH GENERIC AND SPECIFIC SWCL CONCEPTS  
WHICH WILL SIMULATE ACTUAL LASER FLOWS AND THEIR OPTICAL MEDIA.

TETRA CORP  
4905 HAWKINS ST NE  
ALBUQUERQUE, NM 87109  
CONTRACT NUMBER:  
DR E W GRAY  
TITLE:  
MICROSTACK INSULATOR FOR HIGH VOLTAGE PULSED SYSTEMS  
TOPIC# 5                      OFFICE:

POLYMERIC OR CERAMIC INSULATORS CONVENTIONALLY ARE BEING USED IN HIGH  
VOLTAGE PULSED SYSTEMS. NEW APPROACHES ARE NEEDED THAT WOULD REDUCE  
INSULATORS RING THICKNESSES AND INCREASE CORRESPONDING GRADING RINGS  
FLASHOVER VOLTAGE. SUCH AN APPROACH WOULD POSSESS IN COMPARISON TO  
CONVENTIONAL INSULATORS: HIGHER SURFACE FLASHOVER FIELD STRENGTH;  
SMALLER PHYSICAL DIMENSIONS FOR EQUIVALENT VOLTAGE HOLDOFF; LESS  
WEIGHT; AND LESS INDUCTANCE SO THAT MORE POWER CAN BE TRANSMITTED. A  
HIGH VOLTAGE INSULATOR PROTOTYPE IS BEING DESIGNED BASED ON THIS  
APPROACH. A MARX GENERATOR (1MV, 200KA, 150NS) IS BEING CONSTRUCTED  
TO ENABLE A PRELIMINARY TEST OF THE PROTOTYPE INSULATOR STACK. SHOULD  
THIS CONCEPT PROVE VIABLE FOR INSULATOR TECHNOLOGY, INSULATORS THAT  
CAN WITHSTAND FIELD GRADIENTS OF APPROXIMATELY 100 MV/M COULD BE  
PRODUCED AND EFFECTIVELY REDUCE THE DIMENSIONS OF ELECTRON (AND ION)  
ACCELERATOR TECHNOLOGY.

TETRA CORP  
4905 HAWKINS ST NE  
ALBUQUERQUE, NM 87109  
CONTRACT NUMBER:  
DR E W GRAY  
TITLE:  
HIGH POWER LOW IMPEDANCE LIGHT WEIGHT TRANSMISSION LIN  
TOPIC# 5                      OFFICE:



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THE DEVELOPMENT OF HIGH POWER, LOW IMPEDANCE, LIGHTWEIGHT ENERGY STORAGE TRANSMISSION LINES FOR PULSE-POWER APPLICATIONS IS CRUCIAL FOR SMALLER, LIGHTWEIGHT, SPACE-BASED, PULSE-POWER SYSTEMS. DEVELOPMENT OF HIGH DIELECTRIC ENERGY STORAGE LINE TECHNOLOGY WOULD GREATLY REDUCE THE SIZE, WEIGHT, AND COMPLEXITY OF PULSE POWER SYSTEMS UTILIZING THESE TYPES OF COMPONENTS. EFFICIENT TRANSPORT OF 400KV, 100KA FOR APPROXIMATELY 150 NANOSECONDS PULSE HAVE BEEN ACHIEVED. THE FEASIBILITY IS BEING INVESTIGATED OF USING LUCITE/POLYCARBONATE AS LIGHTWEIGHT CHARGED DIELECTRIC LINES UP TO 600KV FOR AN APPROXIMATELY 2 OHM TRANSMISSION LINE. HIGH VOLTAGE STANDOFF, FIELD GRADING OF THE CONDUCTORS, AND QUALITY OF MATERIAL ARE BEING EXAMINED FOR THEIR POTENTIAL TO WITHSTAND 1 MV PULSES. THE INTEGRITY AND INITIAL BOND STRENGTH OF CONDUCTIVE COATINGS ARE BEING ANALYZED TO ENSURE THAT ULTRAVIOLET RADIATION AND IONIZATION SPACE DOES NOT DEGRADE THE DIELECTRICS. LIMITED THEORETICAL EVALUATIONS ARE BEING UNDERTAKEN OF OTHER MATERIALS AND TECHNOLOGIES OF SOLID DIELECTRICS. ISSUES OF REPAIR, CLEANING, MAINTENANCE, AND REUSE OF COMPONENTS IN PULSE GENERATORS ARE BEING INVESTIGATED.

TEXTILE TECHNOLOGIES INC  
2800 TURNPIKE DR  
HATBORO, PA 19040  
CONTRACT NUMBER:  
JANICE R MAIDEN  
TITLE:  
ULTRA-HIGH MODULUS GRAPHITE FIBER WOVEN PREFORM REINFO  
COMPOSITES  
TOPIC# 12                      OFFICE:

THERE IS A GREAT NEED FOR ADVANCED STRUCTURAL MATERIALS FOR A WIDE RANGE OF STRATEGIC DEFENSE APPLICATIONS SUCH AS PRIME POWER SYSTEMS, ANTENNAE, TRACKING AND POINTING SYSTEMS, SOLAR COLLECTORS, AND PRESSURE VESSELS. EACH OF THESE STRUCTURES POSE UNIQUE SETS OF PROBLEMS BUT AT THE SAME TIME PRESENT A NUMBER OF GENERIC REQUIREMENTS. THESE REQUIREMENTS INCLUDE: LIGHTWEIGHT, HIGH STIFFNESS, HIGH STRENGTH, DIMENSIONAL STABILITY, LONG LIFE EXPECTANCY IN THE SPACE ENVIRONMENT, COST EFFECTIVENESS, IMPACT RESISTANCE, AND HIGH TEMPERATURE RESISTANCE. THIS EFFORT IS EXPECTED TO PROVIDE THE STRATEGIC DEFENSE DESIGNER WITH A REINFORCEMENT SYSTEM, WHICH IS IN

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ITSELF ADVANCED AND WHICH CAN BE USED TO REINFORCE A RANGE OF MATRICES. THE FIBER INVOLVED IS THE ULTRA-HIGH MODULUS, PITCH-BASED, GRAPHITE FIBER (MODULUS - 120 MILLION PSI). A UNIQUE WEAVING SYSTEM IS BEING ADAPTED TO HANDLE FIBERS CONSIDERED BY MANY AS UNWEAVABLE TO THE PRODUCTION OF FABRICS AND PREFORMS USING THE ULTRA-HIGH MODULUS GRAPHITE FIBER. THIS COST EFFECTIVE TECHNIQUE WOULD PROVIDE A WHOLE FAMILY OF MATERIALS CAPABLE OF MEETING STRATEGIC DEFENSE NEEDS. IN THE COMMERCIAL ARENA, THERE COULD BE INTEREST IN ADVANCED TURBINE ENGINE DESIGN FOR AIRCRAFT AND LAND BASED POWER GENERATION.

TINI ALLOY CO  
2736 COLLEGE AVE  
BERKELEY, CA 94705  
CONTRACT NUMBER:  
DR A DAVID JOHNSON

TITLE:  
SHAPE-MEMORY DEVICES FOR ACTUATORS IN RELAYS AND CIRCUIT  
BREAKERS  
TOPIC# 14                      OFFICE:

SHAPE-MEMORY ALLOYS (SMAS), WHICH EXHIBIT A DRAMATIC PHYSICAL SHAPE CHANGE IN ASSOCIATION WITH A TEMPERATURE-DRIVEN PHASE CHANGE, PRESENT NEW OPPORTUNITIES FOR DESIGN OF ACTUATING MECHANISMS. ELECTRICALLY ACTUATED SHAPE-MEMORY ALLOY ELEMENTS CAN BE USED AS ACTUATORS FOR RELAYS, CIRCUIT BREAKERS, RESETTABLE FUSES, AND THERMAL SWITCHES. A SHAPE-MEMORY WIRE IN TENSION EXERTS AS MUCH FORCE AS A SOLENOID CONTAINING A WINDING OF COPPER WIRE AND A MAGNETIC CORE BUT WEIGHS ONE THOUSANDTH AS MUCH. SUCH ACTUATORS CAN BE VERY SMALL IN SIZE AND INEXPENSIVE TO MANUFACTURE. THE FEASIBILITY OF SMA ACTUATORS IS BEING DEMONSTRATED. PERFORMANCE CRITERIA ARE BEING ESTABLISHED BY WHICH THESE ACTUATORS MAY BE COMPARED TO EXISTING COMPONENTS. NITINOL SHAPE MEMORY ALLOY WIRES ARE BEING USED TO CONSTRUCT THREE PROTOTYPE SHAPE-MEMORY ALLOY ACTUATORS WHICH DEMONSTRATE THREE POTENTIAL ADVANTAGES: MINIATURE SIZE, SMALL MASS, AND HIGH SPEED. ONE OF THESE PROTOTYPES IS BEING ENGINEERED AS A DIRECT REPLACEMENT FOR AN EXISTING RELAY OR CIRCUIT BREAKER. A SIGNIFICANT PERCENTAGE OF EXISTING RELAYS AND CIRCUIT BREAKERS COULD USE SHAPE-MEMORY ALLOY ACTUATOR TECHNOLOGY AT A COMPETITIVE ADVANTAGE. OTHER NEW TYPES OF COMPONENTS ARE POSSIBLE INCLUDING SOFTWARE RESETTABLE CIRCUIT PROTECTORS.

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ULTRAMET  
12173 MONTAGUE ST  
PACOIMA, CA 91331  
CONTRACT NUMBER:  
R B KAPLAN  
TITLE:  
LIGHTWEIGHT HIGH TEMPERATURE HEAT PIPES FOR SPACE APPL  
TOPIC# 7                      OFFICE:

HIGH TEMPERATURE HEAT PIPE TECHNOLOGY REQUIRES THE USE OF SODIUM OR LITHIUM AS THE HEAT TRANSFER MEDIUM. AT THESE TEMPERATURES, SODIUM AND LITHIUM ATTACK MOST MATERIALS. TUNGSTEN, TANTALUM, AND RHENIUM ARE POTENTIALLY USEFUL CONTAINMENT MATERIALS, BUT EACH HAS A VERY HIGH DENSITY. A SOLID HEAT PIPE MADE FROM ANY OF THESE MATERIALS AND ABLE TO SAFELY CONTAIN THE INTERNAL PRESSURE WOULD BE TOO HEAVY TO BE PRACTICAL FOR SPACE APPLICATIONS. THE FEASIBILITY OF FABRICATING A TUBULAR STRUCTURE WHOSE INNER SURFACE IS MADE OF A REFRACTORY METAL WHICH RESISTS ATTACK BY SODIUM OR LITHIUM AND WHOSE OUTER SURFACE IS HIGH STRENGTH CARBON FIBERS IS BEING DEMONSTRATED. USING AN APPLICATION OF CHEMICAL VAPOR DEPOSITION (CVD) AND FIBER WINDING, THE INNER REFRACTORY METAL PROTECTIVE LAYER IS BEING MADE THIN ENOUGH THAT THE AVERAGE DENSITY OF THE STRUCTURE IS APPROXIMATELY 2 G/CM CUBED. OPTIMIZING THE MATERIALS AND FABRICATION TECHNIQUES AND DEVELOPMENT OF END CLOSURES WOULD BE UNDERTAKEN AT A LATER STAGE.

ULTRAMET  
12173 MONTAGUE ST  
PACOIMA, CA 91331  
CONTRACT NUMBER:  
DR R H TUFFIAS  
TITLE:  
ULTRALIGHTWEIGHT HEAT TEMPERATURE STRUCTURAL MATERIALS  
TOPIC# 2                      OFFICE:

THE CHEMICALLY-BOOSTED KINETIC KILL VEHICLE (KKV) WEAPON IS A NECESSARY COMPONENT OF STRATEGIC DEFENSE. NEW SYSTEMS BASED ON ADVANCED SOLID PROPULSION CONCEPTS ARE CURRENTLY BEING INVESTIGATED.

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THEIR ULTIMATE POTENTIAL CAN BE REALIZED ONLY BY THE DEVELOPMENT OF ULTRALIGHTWEIGHT, HIGH TEMPERATURE, HIGH PERFORMANCE MATERIALS. ONE APPROACH IS THE USE OF SHEATHED FOAM COMPOSITES, THE TECHNOLOGY OF WHICH IS NOT WELL ADVANCED. DENSITY MUST BE REDUCED WHILE STILL MAINTAINING ADEQUATE STRENGTH AND OXIDATION/EROSION RESISTANCE AND IMPROVED WEAR/EROSION SHEATHS MUST BE INCORPORATED. BY AN INNOVATIVE APPLICATION OF CHEMICAL VAPOR DEPOSITION, THE FEASIBILITY OF FABRICATING A NEW CLASS OF MATERIALS (LOWER DENSITY HAFNIUM CARBIDE SHEATHED RHENIUM-FOAM COMPOSITES) IS BEING DEMONSTRATED AS IS ITS PERFORMANCE. IF SUCCESSFUL, THIS MATERIAL WILL BE EMPLOYED EXTENSIVELY IN KKV WEAPONS AND WILL ENHANCE THEIR VIABILITY. OTHER APPLICATIONS WOULD INCLUDE MILITARY ROCKETS AND PROTECTION IN COMMERCIAL AIRCRAFT ENGINES.

UNDERGROUND SYSTEMS INC  
PO BOX 27 - 500 MAIN ST  
ARMONK, NY 10504  
CONTRACT NUMBER:  
STEVEN A BOGGS  
TITLE:  
HIGH ENERGY DENSITY ELECTROLYTIC CAPACITOR  
TOPIC# 5                      OFFICE:

THERE IS A NEED FOR HIGH ENERGY DENSITY STORAGE CAPACITORS WHICH COULD MEET PERFORMANCE REQUIREMENTS OF GREATER THAN ONE JOULE PER GRAM ENERGY DENSITIES AT HIGH VOLTAGES. PRESENTLY AVAILABLE CAPACITORS HAVE AT BEST ROUGHLY 1/3 THE REQUIRED ENERGY DENSITY. ALUMINUM ELECTROLYTIC TECHNOLOGY MAY PROVIDE A SOURCE FOR SUCH CAPACITORS. THE FEASIBILITY IS BEING ESTABLISHED OF DEVELOPING RELIABLE HIGH ENERGY DENSITY ALUMINUM ELECTROLYTIC CAPACITORS FOR PULSED POWER APPLICATIONS. AN UNDERSTANDING OF THE FUNDAMENTAL AND PRACTICAL POWER DENSITY LIMITATIONS OF THIS TECHNOLOGY IS BEING DEVELOPED IN ORDER TO ARRIVE AT PRODUCT CONCEPTS AND POWER DENSITY OBJECTIVES BASED ON SUCH UNDERSTANDING. IN ADDITION, CONCEPTS FOR IMPROVED QUALITY ASSURANCE ARE BEING DEVELOPED SO THAT PRODUCTS OF BOTH HIGH ENERGY DENSITY AND ASSURED PULSE DISCHARGE LIFE CAN BE DELIVERED FOR DEFENSE APPLICATIONS. AREAS BEING ADDRESSED FOR IMPROVEMENT INCLUDE APPLICATION OF NOVEL ELECTROLYTES, OPTIMIZATION OF CAPACITOR WINDING, IMPROVED DIELECTRICS, AND IMPROVED ELECTRODE SURFACES. VARIOUS

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DEFENSE APPLICATIONS COULD BENEFIT FROM A HIGH ENERGY DENSITY ELECTROLYTIC CAPACITOR, INCLUDING SPACE-BASED DIRECTED ENERGY AND KINETIC ENERGY SYSTEMS REQUIRING NON-NUCLEAR, LIGHTWEIGHT AND DURABLE HIGH ENERGY POWER SOURCES AND POWER CONDITIONING.

VISIDYNE INC  
10 CORPORATE PL - S BEDFORD ST  
BURLINGTON, MA 01803  
CONTRACT NUMBER:  
ORR SHEPHERD  
TITLE:  
LASER KILL ASSESSMENT  
TOPIC# 3                      OFFICE:

LASER KILL ASSESSMENT IS OF PRIMARY IMPORTANCE TO THE FEASIBILITY OF CHEMICAL LASERS AS DIRECTED ENERGY WEAPONS (DEW) FOR A SPACE-BASED BALLISTIC MISSILE DEFENSE SYSTEM. PROMPT, RELIABLE INDICATION FROM A DEW IRRADIATED TARGET THAT KILL WILL OCCUR IS SIGNIFICANT BECAUSE TESTING HAS DEMONSTRATED THAT TARGET DESTRUCTION CAN OCCUR TEN SECONDS AFTER LASER BEAM IRRADIATION ENDS. THUS, THE TIMELINESS OF THE DETECTION OF THE KILL SIGNATURE WILL DIRECTLY IMPACT THE NUMBER OF DEWS IN THE STRATEGIC DEFENSE SYSTEM. THE FEASIBILITY IS BEING EVALUATED OF PERFORMING LABORATORY MEASUREMENTS DIRECTLY RELEVANT TO LASER KILL ASSESSMENT. BASED UPON THE EVALUATION OF HIGH RESOLUTION SPECTRAL MEASUREMENTS PREVIOUSLY UNDERTAKEN, A DETERMINATION IS BEING MADE WHETHER LASER BACK SCATTER SIGNATURES, BOTH CONTINUUM AND LINE, CAN BE USED AS RELIABLE AND EARLY TARGET KILL INDICATORS. SPECIFIC MATERIALS ARE BEING IDENTIFIED FOR CONSIDERATION AS RADIATION TARGETS AND AN APPROPRIATE RADIATION SOURCE SELECTED. EXPERIMENT SCALING FACTORS ARE BEING RIGOROUSLY EVALUATED. SPECIAL MEASUREMENTS ARE BEING MADE AND THE DATA ANALYZED. BASED ON THE RESULTANT DEVELOPMENT OF ONE OR MORE KILL ASSESSMENT CRITERIA, A SET OF RECOMMENDATIONS ARE BEING PREPARED FOR LATER FIELD TESTING.

WINZEN INTERNATIONAL INC  
6800 PARK TEN BLVD - STE 126 E  
SAN ANTONIO, TX 78213  
CONTRACT NUMBER:  
JAMES S WILBECK  
TITLE:  
COMPOSITE FRAGMENT LETHALITY ENHANCEMENT  
TOPIC# 2                      OFFICE:

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CURRENT SPACE-BASED KINETIC ENERGY SYSTEMS ARE BASED LARGELY UPON HIT-TO-KILL CONCEPTS DUE TO THE RESTRICTIVE WEIGHT REQUIREMENTS. THE FEASIBILITY IS BEING INVESTIGATED OF DESIGNING A COMPOSITE FRAGMENT WHICH MAY BE LAUNCHED BY WARHEADS CURRENTLY UNDER DEVELOPMENT AND WHICH WOULD HAVE ENHANCED LETHALITY AGAINST REENTRY VEHICLES BY ALLEVIATING THE NEED FOR SYSTEM-LEVEL, ZERO-MISS DISTANCE REQUIREMENTS. THE COMPOSITE FRAGMENT MAKES USE OF THE OBSERVATION THAT FRACTURE WILL NOT OCCUR ON THE BOUNDARY DUE TO THE STRESSES GENERATED BY A TYPICAL HYPERVELOCITY IMPACT. BY LOCATING THE HIGH DENSITY MATERIALS ON THE BOUNDARIES, FRAGMENT BREAK-UP, EXCEPT FOR THE LOW DENSITY CORE, IS MINIMIZED LEAVING RELATIVELY LARGE ENERGETIC PARTICLES IN THE RESULTING DEBRIS CLOUD. TWO-DIMENSIONAL HYDROCODE STUDIES ARE BEING CONDUCTED OF A TYPICAL MONOLITHIC FRAGMENT IMPACTING THE OUTER SURFACE OF A REALISTIC THREAT TARGET (REENTRY VEHICLE, BOOSTER, OR POST-BOOST VEHICLE) FOR COMPARISON WITH A SIMILAR EVENT USING THE COMPOSITE FRAGMENT. THE MONOLITHIC FRAGMENT PREDICTION IS BEING COMPARED WITH RECENT EXPERIMENTAL DATA TO QUANTIFY THE MEASURE OF DAMAGE TO THE TARGET OR LETHALITY OF THE FRAGMENT. THE DAMAGE RESULTING FROM IMPACT OF THE DEBRIS CLOUDS AGAINST A GENERIC BACK-UP STRUCTURE ARE BEING PREDICTED FOR BOTH THE MONOLITHIC AND COMPOSITE FRAGMENTS. THESE DAMAGE LEVELS ARE BEING COMPARED TO ASSESS INCREASED LETHALITY OF THE COMPOSITE FRAGMENT.

XI MAGNETICS INC  
RD 4 - BOX 457  
COATESVILLE, PA 19320  
CONTRACT NUMBER:  
DR JOHN L WALLACE  
TITLE:  
LITHIUM-IMPREGNATED ARMATURES FOR RAILGUNS  
TOPIC# 2                      OFFICE:

MULTILAYER THIN FILM TECHNOLOGY IS BEING USED TO DEVELOP TRANSITIONAL ARMATURES FOR RAILGUNS BASED ON COMPOSITES OF LITHIUM COMPOUNDS WITH OTHER LIGHT ELEMENTS SUCH AS CARBON OR ALUMINUM. TRANSITIONAL ARMATURES ARE IMPORTANT FOR ALL TYPES OF RAILGUNS BECAUSE THEY OFFER THE PROMISE OF ACHIEVING EXTREMELY HIGH VELOCITIES IN THE PLASMA PHASE WHILE MINIMIZING RAIL DAMAGE AT THE BEGINNING OF THE LAUNCH. ARMATURES ARE BEING FABRICATED USING A LITHIUM-BEARING MULTILAYER STRUCTURE ON

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AN ALUMINUM FOIL SUBSTRATE. FOR THIS FABRICATION PROCESS, AN APPROPRIATE DEPOSITION TECHNIQUE IS BEING PERFECTED. THE LAYER STRUCTURE AND CHEMICAL COMPOSITION DISTRIBUTION OF SOME SAMPLES ARE BEING CHARACTERIZED BY MEANS OF SECONDARY ION MASS SPECTROSCOPY, DEPTH PROFILING, AND THIN SECTION SCANNING TRANSMISSION ELECTRON MICROSCOPY STUDIES. IF SUCCESSFUL, THIS STUDY WOULD LEAD TO IMPROVED RAILGUNS AND SIMILAR DEVICES, WHICH IN TURN ARE APPLICABLE TO LETHALITY TESTING, ANTI-ARMOR WEAPONS, INERTIAL FUSION, KINETIC ENERGY DEVICES, AND FUNDAMENTAL STUDIES OF THE PROPERTIES OF MATTER AT HIGH PRESSURES.

XON-TECH INC  
6862 HAYVENHURST AVE  
VAN NUYS, CA 91406  
CONTRACT NUMBER:  
THEODORE D FAY  
TITLE:  
INFRA-RED SENSOR CALIBRATION  
TOPIC# 3                      OFFICE:

INFRARED SENSOR CALIBRATION UNCERTAINTIES HAVE RESULTED IN CONFUSION OF FLIGHT TEST DATA FOR SENSORS VIEWING IDENTICAL OBJECTS. THIS HAS LED TO DIVERGENT INTERPRETATIONS OF STRATEGIC TARGET PHENOMENOLOGY IN THE EXO-ATMOSPHERE REGION. THE RESOLUTION OF THIS CONTROVERSY IS CRITICAL TO THE FURTHER MODELING, DEVELOPMENT AND TESTING OF INFRARED SENSORS FOR STRATEGIC DEFENSE APPLICATIONS. THE CALIBRATION ACCURACY OF FIVE SELECTED STARS IS BEING ANALYZED TO DEVELOP AN INFRARED STELLAR DATABOOK CONTAINING ABSOLUTE STANDARDS FOR USE BY THE INFRARED COMMUNITY. THIS ANALYSIS IS CONSIDERING DATA OVER THE 0.2 - 100 MICRON WAVELENGTH REGIONS FROM VARIOUS BASED SENSORS. PRELIMINARY RESULTS SHOW THE CONSISTENCY OF THESE MEASUREMENTS FOR A STAR SUCH AS ALPHA TAU TO BE BETTER THAN 6% (1 SIGMA). THE REQUIREMENTS FOR A SIMPLE BUT FUNDAMENTALLY ACCURATE CALIBRATION SENSOR ARE ALSO BEING DEFINED. THIS SENSOR WOULD ENABLE THE CROSS CALIBRATION OF EXISTING GROUND CHAMBERS, SUCH AS PORTABLE OPTICAL SENSOR TESTER (POST) AND ADVANCED SENSOR EVALUATION AND TEST (ASET), AND LINKING OF THESE CHAMBER CALIBRATIONS WITH THE STELLAR INFRARED STANDARDS. THE ABSOLUTE ACCURACY ACHIEVABLE WITH THIS SENSOR IS ANTICIPATED AT 3% (1 SIGMA). THIS ANALYSIS IS NEEDED BY THE INFRARED COMMUNITY (GOVERNMENT, INDUSTRY, UNIVERSITY) TO CONSOLIDATE AND COLLABORATE THE

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EXISTING INFRARED DATABASE.

XSIRIUS SCIENTIFIC INC  
4676 ADMIRALTY WY - STE 530  
MARINA DEL REY, CA 90292  
CONTRACT NUMBER:  
JOSEPH MOYSON  
TITLE:  
LARGE AREA HIGH DENSITY ARRAYS OF SILICON AVALANCHE PH  
WITH MODIFIABLE SPECTRAL RESPONSE  
TOPIC# 3                      OFFICE:

THE MAJORITY OF APPLICATIONS FOR SOLID STATE PHOTODETECTORS INVOLVE PASSIVE DETECTION OF BROADBAND RADIATION IN WHICH THE MAJOR SOURCE OF SYSTEM NOISE IS THE RANDOM FLUCTUATIONS OR SHOT NOISE IN THE DIRECT CURRENT BACKGROUND. MILITARY APPLICATIONS, HOWEVER, REQUIRE OPERATION OVER VERY NARROW SPECTRAL BANDS (LASER GUIDED SEEKERS, TRACKERS, AND RANGEFINDERS). FOR THESE USES, SHOT NOISE DUE TO THE RANDOM GENERATION AND RECOMBINATION OF CARRIERS IN THE DETECTOR (DARK CURRENT) OR THERMAL NOISE IN THE PREAMPLIFIER LIMITS SYSTEM SENSITIVITY. THE NEED EXISTS TO IMPROVE RECEIVER SENSITIVITY BY REDUCING THE DETECTOR DARK CURRENT (POSSIBLY BY COOLING) AND BY ENHANCING THE SIGNAL BEFORE AMPLIFICATION. THIS IS THE ROLE OF INTERNAL AVALANCHE GAIN. A NEW TECHNOLOGY IS BEING INVESTIGATED FOR FABRICATING HIGH AND UNIFORM VALUES OF AVALANCHE IMPACT IONIZATION ELECTRON GAIN IN SILICON AVALANCHE PHOTODEVICES. DATA IS BEING ACQUIRED FOR SUBSEQUENT DESIGN OF LARGE ARRAY, SINGLE AVALANCHE PHOTODEVICE SUBSTRATES. CURRENTLY AVAILABLE SILICON CRYSTAL WITH SELECTED PROPERTIES IS BEING SEARCHED OUT, TESTED, AND EVALUATED FOR THE PURPOSE OF QUANTIFYING AND ASSESSING POTENTIAL PROBLEMS EXISTING IN THE SILICON AS PRESENTLY GROWN OR PROCESSED.

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TOTAL NUMBER OF AWARDS: 212



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